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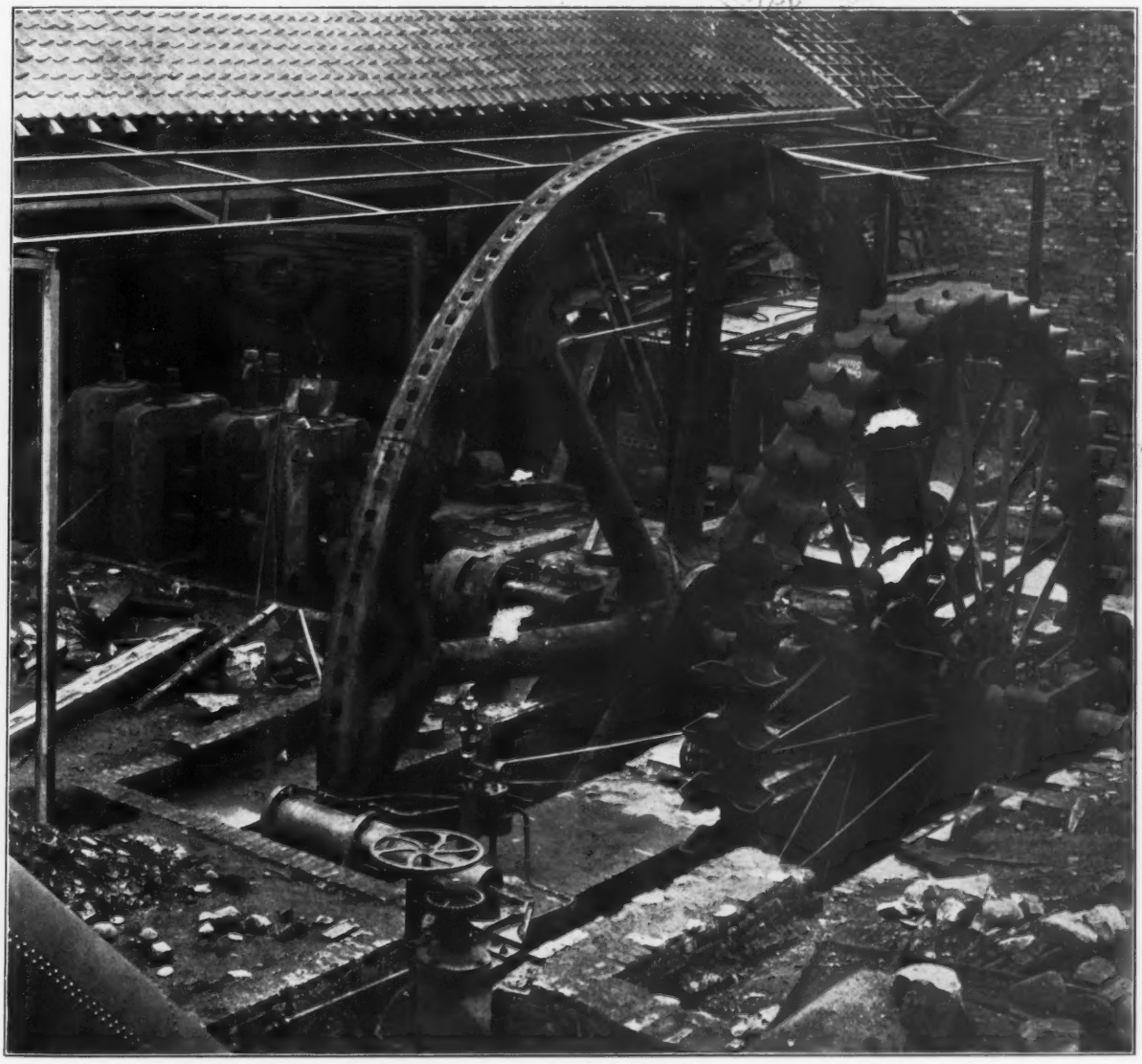

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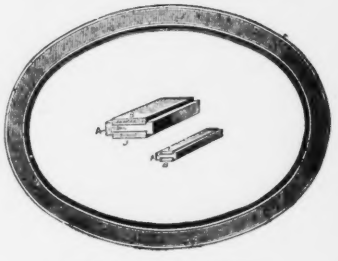

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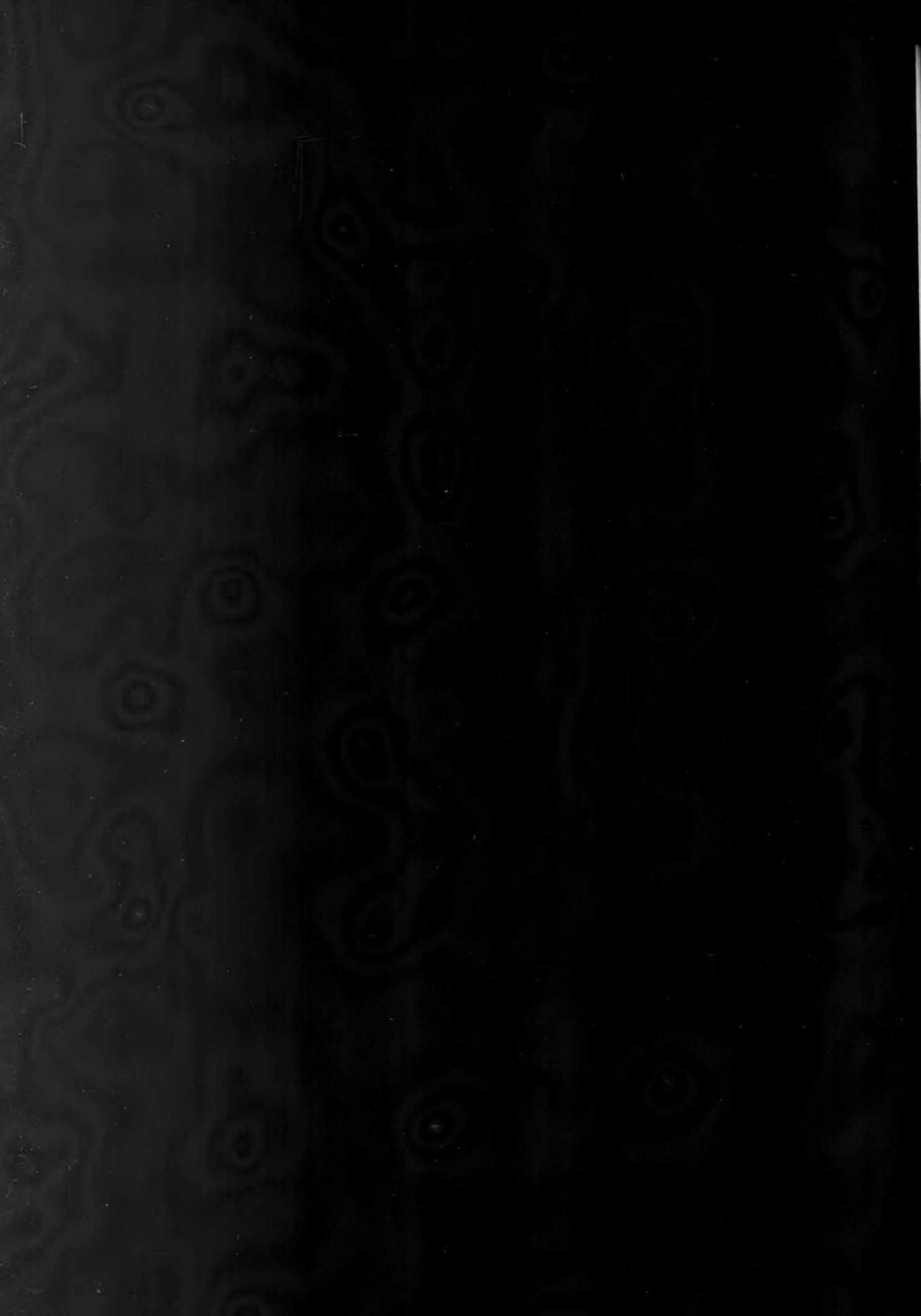

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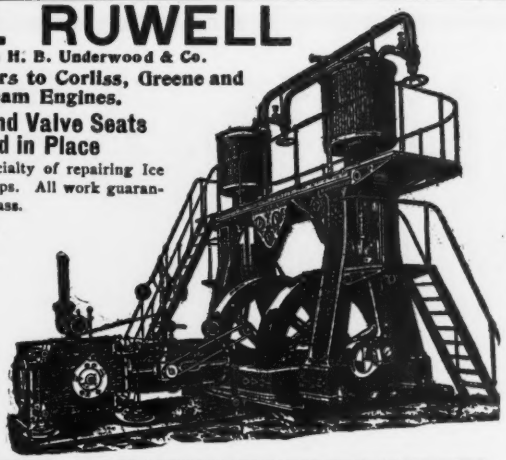

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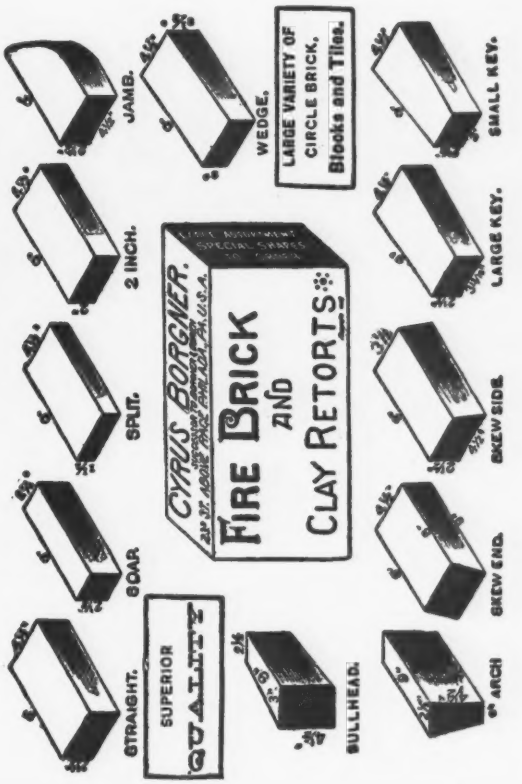

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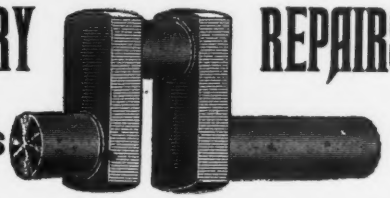

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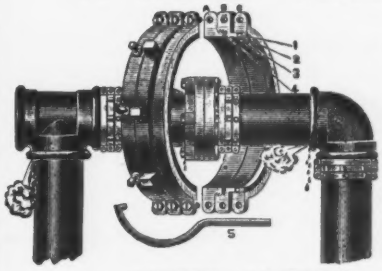

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BLOW-OFF VALVES AND PIPES.

BY W. H. WAKEMAN.

Why do engineers disagree concerning the proper time to use the blow-off valve on a steam boiler? To the casual observer it appears as if this was a very simple question to settle, yet it is not, and nobody believes that this article will decide it, although it will present some reasons for this disagreement, also for following certain plans along this line that have proved beneficial in the past, consequently there is no doubt of their value now.

Some men in charge of plants seem to believe that their blow-off valve is to be used when it is necessary to let all of the water out of their boilers, and seldom or never at any

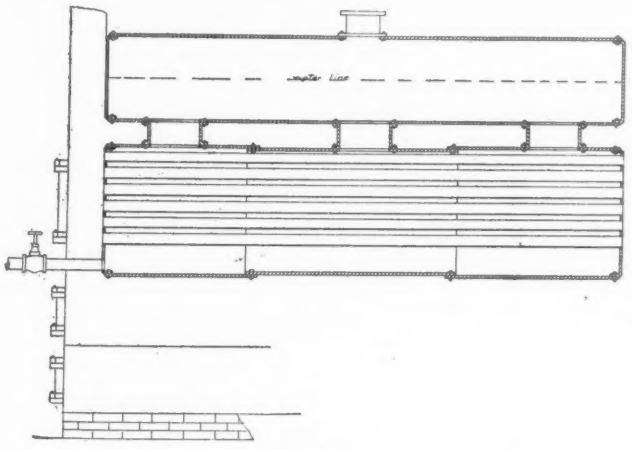


Fig. 1.

other time. If this could be considered good practice, it would relieve some of us of much care and labor in the course of a year, but we fear that this desirable state of affairs will never be realized, for the simple reason that we shall never be able to obtain pure water.

The preceding sentence is sure to be read by some who will think that they have an abundance of pure water at hand, because it looks clear when a sample of it is held up to the light, and is excellent for drinking.

"All is not gold that glitters," and all water that looks clear and tastes nice is not fit to use in a steam boiler, because heating it to a high temperature causes some of the scale making impurities, which are not visible to the naked eye, to settle to the bottom, or float on the top of the body of water in the boiler.

Of course, this is well understood by engineers and they are all agreed on it, but when we come to consider plans for removing these impurities opinions differ greatly.

Live steam heaters and purifiers are installed in plants where very impure water must be used and they prove very efficient in removing foreign matter from the water before it enters the boilers. Other plans are sometimes adopted for the purification of water, but in the great majority of cases it goes into the boilers in its natural state, making it necessary for the engineer to dispose of mud and scale as best he can.

When a boiler can be spared for a day it is emptied, washed out and refilled with clean water. This, of course, removes all impurities, but this is not sufficient because these opportunities do not come near enough together to prevent formation of hard scale, therefore measures must be taken to remove some of them while the boiler is in use. The boiler is filled nearly full, then the blow-off valve is opened and the water level lowered to the first gage, much impure water being thus disposed of.

Suppose that we have a battery of boilers supplying steam for power purposes in a shop that is run nine hours per day. When is the best time to blow down these boilers?

Some engineers will answer that it should be done when the fires are burning brightly and much steam is wanted, because the sediment is then well distributed through all of the water, consequently if any of it is taken out, some of the sediment must come with it. That sounds good and is good too, so far as it goes, but is it the best way to do?

When I was a boy, my father bought a hogshead of molasses that came from the West Indies, and put it in the cellar. It did not take me long to find that we had materials for the

foundation of a rich feast, for after it had time to settle, there was about three inches of sugar in the bottom of it. If I had stirred that molasses until the sugar was thoroughly distributed through the whole, then taken out a quart of the mixture, some of the sugar would have been in it without doubt, but that was not enough to answer my purpose, so I found a way to get it right from the bottom, and it was rich.

Does not this principle apply to the ordinary steam boiler? If we wait until the water has been quiet for several hours, allowing sediment to settle, then open the blow-off valve, shall we not get more impurities than by waiting until the fire

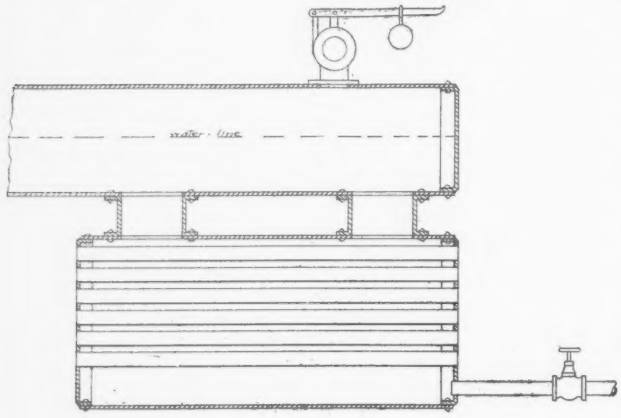


Fig. 2.

is burning briskly, creating rapid circulation and mixing the scale-forming matter through all water in the boiler? It not only seems reasonable to conclude that we do, but so far as my observation has extended, practice proves theory to be correct.

Perhaps the location of a blow-off pipe will make a difference about the proper time to open the valve. Several years ago I had charge of a boiler in which the blow-off pipe was connected into the front head, as illustrated in Fig. 1. As it was 2 inches above the crown sheet, (or the sheet directly over the fire), some of the water always remained in it after the fire was out and the blow-off valve had been left open for an hour. In such a case, some of the sediment is sure to remain in the boiler without regard to the time selected for opening the blow-off valve.

The worst feature of this case was that the pipe could not be moved without much labor and expense, because the rear of boiler was higher than the front, therefore if a hole had been bored in the rear sheet and the pipe put where it belonged it would still fail to drain all of the water out unless the rear end was lowered.

In order to be fair in the matter, it may be well to state that there is one good point about this plan, for it removes the blow-off pipe from the action of fire, and places it in plain sight. However, the bad features sadly overbalance the good ones in this case.

In another plant I found the blow-off pipe at the rear of boiler, where it belongs, but it was in the rear head, as illustrated in Fig. 2, instead of in the bottom of shell. This was the worst plan that I ever saw put into practice, for not only was it impossible to drain all of the water out, but the valve was in the combustion chamber. It was not exposed directly to the flames on their way to the chimney, but was almost as bad, because it was necessary to open an iron door and go into the hot chamber every time that the engineer wanted to blow down the boiler. I am quite sure that this was done as seldom as possible.

In this case, it was possible to change it with little trouble and it was done at once, as the boiler was not in use at that time. When the job was finished it appeared as shown in Fig. 3, in which the pipe is connected into the bottom of shell, and the asbestos packed cock is located outside of the side wall of setting, as shown. Sometimes we find an objectionable feature that is due to other conditions, but in this case there was absolutely no reason for it except failure of the engineer in charge to grasp the situation.

When the blow-off pipe of a boiler is located in the combustion chamber it should be carefully covered with something that will protect it from the direct action of flames on their way to the tubes. It is not a good plan to make this a permanent fixture, as for instance, by putting a piece of larger pipe over it, as a blow-off pipe ought to be carefully inspected at least once each year, and its exact condition noted.

This covering is especially required where the boiler is not fed through the same pipe, as intense heat may evaporate all of the water in it, causing it to be burned.

Whatever may be said in favor of blowing down a boiler when a brisk fire is burning under it, so far as removing sediment is concerned, does not make it safe, and there is always danger of something happening to prevent the engineer from closing the blow-off valve when he desires to. This is a strong point in favor of blowing down when the fire is banked, as in that case no harm would be done if all of the water was blown out.

Another point on which engineers disagree is the frequency with which it is necessary to open a blow-off valve. There seems to be no good reason for opening it more than once per day of nine hours, as many years experience and observation along this line convince me that this is sufficient. Of course, there are many cases where once during the week, (say Wednesday morning), is considered enough, provided the boiler is filled to a higher point and blown down lower on Sunday that at other times, but in a large majority of such cases the engineer complains of scale collecting too rapidly and that is enough to condemn the practice.

If an engineer claims that my practice in using the blow-off every day is not correct, I have nothing to say provided his plan proves successful in keeping boiler clean, but if he is worried because the spaces between tubes at the rear end of his boilers are growing smaller each month, it appears as if it would be a good idea for him to try a better plan.

A blow-off valve or cock should always be opened slowly in order to prevent water from travelling rapidly through the pipe until it strikes an ell or a tee, the resulting blow breaking either the pipe or some of the fittings. While it is wide open, a column of water travels rapidly through it and the pipe, therefore if it is closed quickly the momentum of this water is suddenly checked, bringing a heavy strain on all parts between the valve or cock and the boiler. On this account a gate valve is superior to a cock as it cannot be closed quickly enough to cause trouble.

There are many poor gate valves in the market, and for

this reason some engineers, including the writer, will not use a valve of this type if it can be avoided, but a nickel seated gate valve will last a long time, therefore its greater first cost proves a good investment.

The asbestos packed plug cock does not give universal satisfaction, but the reason for such failures is not plain, except that several years ago many of them were spoiled by turning the plug through one-half or even a complete revolution when opening and closing it, instead of turning it one-quarter revolution to open, then putting it back to its former position to close it. When the manufacturers of these cocks discovered this abuse of them they changed the design, therefore it is impossible to turn any of the later ones more than one-quarter revolution.

I have used two of these cocks in my present plant for nearly ten years and they are still tight. Three more have seen a shorter term of service, but are satisfactory. Previous to this I used a pair of them in another plant for about four years without trouble of any kind, and before this experience I had found them satisfactory. On this account I do not understand why others do not approve of them, as the beforementioned experience covers about all of the conditions found in practice, including one that was located out in a yard where it was necessary to lock it up to render it safe from the experiments of inquisitive visitors.

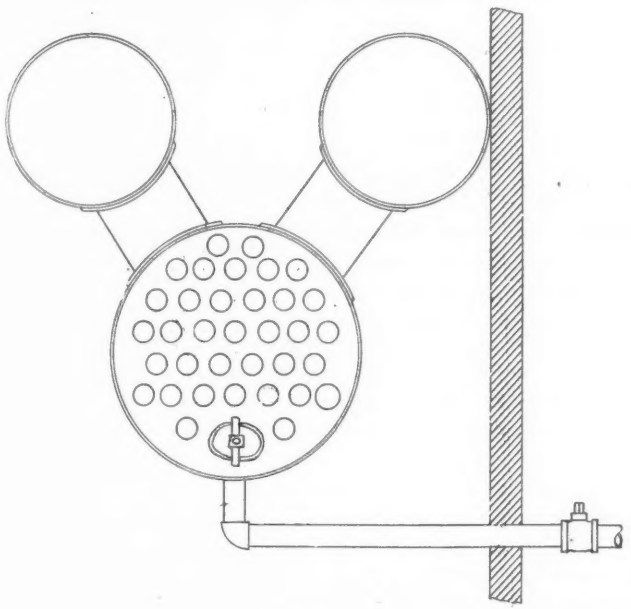


Fig. 3.

A common brass plug cock is unsuitable for use on the blow-off pipe of a steam boiler, as the repeated contraction and expansion render it liable to "stick," making it impossible to open and close it at pleasure. To overcome this objection the nut on small end of plug is sometimes loosened, and in one case that I remember, it was taken off entirely. The next time that an attempt was made to use it, the plug was blown out and all of the water soon followed, but fortunately nobody was injured.

In another case, a man in charge of a boiler broke off the stud which supported the nut, and did not consider it necessary to have repairs made until the plug blew out, and the boiling hot water which followed scalded him badly.

Occasionally we find an engineer who still favors a globe valve with a hard rubber disk for this service, but they are few and far between, and if their number was less there would be no cause for complaint.

The idea of using a hard rubber disk that can be renewed when there is no pressure on the valve is all right, but that type of valve is all wrong for this service. It is usually possible to use an angle or a cross valve, and they can easily be fitted with a new disk when necessary. They are much superior to a globe valve, as they provide an opening equal to the area of corresponding pipe, which is more than can be said of the ordinary globe valve.

The Y valve with hard rubber disk affords an easy passage for water, and possesses all desirable features found in the globe valve. If connected so that pressure comes on top of the disk when closed, it will remain tightly shut until opened intentionally.

On account of trouble with various valves, the plan of putting two blow-off valves or cocks on one pipe has been adopted in many cases with satisfaction. Whenever this is done, they should always be located close together and care taken to open the outer one first. If located several yards apart and the inner one is opened first, the projected column of water will strike the outer with more or less force, which is dangerous.

When closing these valves under ordinary conditions it makes little difference which is closed first, provided they are both alike, but if a plug cock is placed next to the boiler and a gate or a globe valve is beyond it, the latter should be closed first because by so doing pieces of scale are less liable to be caught under the disks as they will be swept through by the force of moving water.

When this pipe is filled with cold water, as it may be after washing out the boiler, care should be taken to close the inner valve or cock first, for if cold water is trapped between them and it is afterward heated, the resulting expansion may strain one or both of the valves, as it is possible to create a heavy pressure in this way.

Some Facts about Fuels.

All fuels used in engineering consist of compounds of carbon and hydrogen, which when uniting with the oxygen in the air, produce heat. Since these two elements are very widely distributed in nature, there are a great number of compounds which may be said to come under that head. Popularly, fuels belong to that class of compounds which are usually of vegetable origin, except animal oils and fats, and which, when raised to a kindling temperature, produce both light and heat. That is, not only do coal, coke, wood, charcoal, peat or turf come under that head, but tallow, alcohol, coal gas and other gases, petroleum and creosote are also classed as fuels.

On account of the various substances popularly known as fuels, they are classified according to the three states in which they occur: that is, solid, liquid and gaseous. The solid fuels are anthracite and bituminous coal, lignite, peat, charcoal, coke and wood. Among the liquid fuels may be mentioned mineral, vegetable, and animal oils. The gaseous fuels are natural gas

and various artificial gases, such as coal gas, naptha gas and the like.

Of all the fuels, coal is the most important and most widely used, and in many localities it is the only available fuel. In some places where gas, oil or wood is abundant, on account of the lesser cost, they take the place of coal and in factories where such by-products as saw-dust, straw, begasse and tan are available, these fuels are more economical, but in general, coal is the chief fuel in use to-day.

Coal consists of four general varieties, depending upon its state of decomposition: namely, anthracite, bituminous, cannel and lignite. There are stages between each of these divisions, but in general these are the four different kinds usually spoken of. Of all the coals, anthracite is the hardest. It contains nearly all carbon and burns without smoke or flame at an intense heat. It is a jet bright black color and is quite brittle. It occurs in the market in various sizes, which are determined by the size screen they will go through. The general commercial sizes are known as egg, stove, chestnut, pea, buckwheat, rice and barley. Egg coal will go through a screen 2.5 in diameter, but will pass over a screen having 1.75-inch holes. Stove coal will pass through 1.75-inch screen, but will go through a 1.25-inch screen and the same for the smaller coals. Chestnut varies in size from 1.25 to 7/8-inches in diameter; pea coal, 7/8 to 9-16-inches in diameter; buckwheat, 9-16 to 3/8-inches; rice, 3/8 to 3-16-inches, and barley 3-16 to 3-32-inches.

Bituminous coal is a soft coal which contains less carbon than anthracite, but more hydrogen, and on account of its lower price and more widely-extended fields, it is the chief form of fuel in most districts far from the anthracite fields of Pennsylvania and Colorado. Commercially it exists in almost any size from large lumps to fine dust. Besides its general use for heating, it is largely used for making illuminating gas.

Cannel coal contains still less carbon and is softer and duller in color than bituminous. It burns with a long flame and emits large quantities of smoke if not fired properly, on account of its caking tendency.

Lignite is the lowest order of coal. It is brownish-black in appearance and contains from 55 to 70 per cent. of carbon, depending upon the locality where it is found, which is principally in Washington, Texas and Colorado.

Next in value to lignite as a fuel is peat, which is widely used in Europe. It consists principally of decayed roots and earthy matter, and is found in bogs or swamps from which it is cut. When dried it becomes a fairly good fuel, but is very bulky and for this reason is often pressed into briquettes and sold in that shape.

Wood is the lowest order of natural fuel principally on account of the large amount of water which it contains. It is divided into two classes: hard and soft woods, and while hard wood is a better fuel per cubic foot on account of its greater density, yet there is very little difference in their heating value per pound, which is about 8000 heat units when dried and about 6000 heat units when in its natural state.

Because some solid fuels contain more moisture than others, they are divided into two classes: those containing water and those that are purely carbonaceous. Wood, turf and most coals are classed among the fuels containing moisture and therefore they produce when burning, hydrogen and carbon. The carbonaceous fuels are coke, charcoal and anthracite.

Coke is made from bituminous and cannel coals by driving off the hydrocarbons by means of heat. The best coke is made in coke ovens, where the gases that are driven off are burned, but where the coke is a by-product in the manufacture of gas it usually has a less heating value and is of a lower grade of fuel.

Charcoal is rarely used for steaming purposes. It is formed by condensing the carbon of the wood and expelling the hydrogen and the oxygen, just as coke is a concentration of coal. The wood is packed and closed in to prevent the access of air, and is raised to a temperature of about 300 degrees. The water and gaseous particles are entirely expelled and a mass of almost pure carbon remains.

The principal constituents in all fuels are carbon and hydrogen. A pound of carbon will give out 14,500 heat units and a pound of hydrogen 62,500 heat units. It might seem from this that of two fuels, very similar in the proportion of carbon and hydrogen, the one containing the most hydrogen would give out the most heat. This may or may not be true. It depends entirely upon how much oxygen is present. When hydrogen and oxygen exist in a compound in the proper proportion to form water, that is, one part hydrogen and eight parts oxygen by weight, these constituents will have no effect upon the total heat of combustion, but if hydrogen exists in greater proportion than this, only the surplus above that which is required by the oxygen is to be considered in the heating value.

The following is a general formula for finding the total heat of combustion of the fuel when the amount of hydrogen, carbon and oxygen are known. Let C, H, and O, be the fractions of one pound of carbon, hydrogen and oxygen in the fuel, and let h be the total heat of combustion of one pound of the fuel in British thermal units. Then $h = 14{,}500\ C + 62{,}500\ (H - \frac{O}{8})$ which will give the theoretical heating value based upon these amounts in the fuel, the remainder being nitrogen, ash and other impurities.

As regards the origin of the formation of the different kinds of coal, the generally accepted theory is that the rank and luxuriant vegetation which prevailed during one of the periods of the earth's formation became covered with water, which in turn became covered with dirt and silt, once more covered with a dense mass of plants which in course of time decayed, sank and became overlaid with silt and sand as before. At length thick masses of stratified matter would accumulate, due probably to this and the upheavals of the earth, producing great pressure, and this acting along chemical lines would gradually mineralize the vegetable layers into coal. It seems that the many coal seams simply represent great swamps and marshy jungles.

The formation of wood, peat, lignite, soft coal and hard coal, represents stages in the formation of this process and the following table will show how gradually these substances pass into each other:

	Carbon.	Hydrogen.	Oxygen.
Wood	49.5	6.2	44.3
Peat	60.0	6.5	33.5
Lignite	65.7	5.3	29.0
Bituminous Coal	82.6	5.6	11.8
Anthracite Coal	91.2	4.3	4.5

These are approximate values based upon a number of actual analyses.

The analyses of different fuels belonging to the same class differ and differ widely. In fact, coal from the same mine differs from place to place and in making the analysis of the run of a mine, samples from all parts must be taken if even a general value is to be obtained and relied upon.

The following table is an analysis of different kinds of coals, giving the values in per cent. of the weight.

	Water.	Volatile Matter.	Fixed Carbon.	Ash.	Sulphur.
Penna. Anthracite	3.16	3.72	81.14	11.08	0.90
Penna. Semi-Bituminous	1.14	17.18	73.42	6.58	1.41
Penna. Bituminous	1.26	30.1	59.61	8.23	0.78
Southern Bituminous	1.75	26.6	60.1	11.52	1.49
Indiana Bituminous	2.10	37.3	57.9	2.60	
Western Lignites	3.54	30.84	50.7	14.9	

All of these values, however, vary so much that they merely give the mean value of the varying results.

The theoretical heating values of these various fuels are given in the following table:

	Per cent. of ash.	Theoretical value. In heat units.	Pounds of water evaporated.
Penna. Anthracite	3.49	14,199	14.70
Penna. Cannel	15.02	13,143	13.6
Penna. Connellsville	6.50	13,368	13.84
Penna. Semi-Bituminous	10.70	13,155	13.62
Penna. Brown	9.50	12,324	12.75
Kentucky Caking	2.75	14,391	14.89
Kentucky Lignite	7.00	9,326	9.65
Indiana Caking	5.66	14,146	14.64
Indiana Cannel	6.00	13,097	13.56
Cumberland Maryland	13.88	12,226	12.65
Arkansas Lignite	5.00	9,215	9.54
Colorado Lignite	9.25	13,562	14.04
Texas Lignite	4.50	12,962	13.41
Washington Lignite	3.40	11,551	11.96

This table gives the heat units per pound of combustible for perfect combustion of different kinds of coals, and the theoretical number of pounds of water that would be evaporated if all the heat was given up to the water.

The actual evaporation is very much less than shown above, but it is an indication of the ability of the coal to perform a certain amount of work. The Geological Report of the United States for 1900 gives the following actual results:

Kind of coal.	Pounds of water evaporated at 212° per pound of combustible.
Pittsburg Lump and Nut, Penna.	10.0
Pittsburg Nut and Slack, Penna.	8.0
Anthracite, Penna.	9.8
Indiana Block	9.5
Georges Creek Lump, Maryland	10.0
New River, W. Virginia	9.7
Pocohontas Lump, W. Virginia	10.5
Cape Breton, Canada	9.2
Carbon Hill, Washington	7.6

These are average results obtained in practice, as the theoretical evaporation is less owing to various losses in the boiler and furnace because some heat is lost by radiation, a certain percentage of the heat goes up the chimney, air in excess of the required amount enters the fire box and reduces evaporation. Such losses give a general value of 10 pounds of water per pound of coal with an average efficiency of the boiler of about 75 per cent.

The most widely-used liquid fuel is petroleum, which is a compound of carbon, hydrogen and oxygen. In its crude state, it gives a heating power of about 20,500 heat units, which corresponds to an equivalent evaporation of 21 pounds of water from and at 212 degrees. It has many advantages and disadvantages as compared with coal, but except in certain localities, its use is limited by the price. When used as a fuel it is projected into the furnace in the form of a fine spray by means of a nozzle through which superheated steam or compressed air is forced.

Gas has many advantages over other kinds of fuel and is widely used in natural gas districts, but is not generally economical for power when made from coal. The following table gives the calorific value of different fuels in the order of heating value:

	Approx. total heat of combustion of 1 pound of fuel. Thermal units.	Equivalent evaporation from and at 212° F. per pound of fuel. Lbs. water.
Hydrogen	62,000	64.20
Petroleum oils (benzine, etc.)	27,500	28.56
Petroleum, crude	20,400	21.13
Petroleum, refuse	20,000	20.70
Coal gas	17,800	18.43
Coal, good average quality	14,700	15.22
Carbon, pure	14,500	15.07
Coke	13,500	13.87
Wood charcoal	11,000	11.39
Wood, air dried	8,000	8.28
Straw	8,000	8.28
Peat, 25 per cent. moisture	7,000	7.25

About the only other important fuels which are not mentioned above are tan or bark, and bagasse. Tan is oak bark which has been used in the process of tanning. It contains 30 per cent. of water in its natural state and when burned that way gives out about 4500 heat units, but when dry it gives out 6100 heat units per pound with a residue of ash equivalent to 15 per cent. of its weight. Bagasse is the name given to the fibrous portion of sugar cane after the juice has been extracted. Unless dried, it is very difficult to burn and as usually burned only contains one-fifth the heating value of the same amount of coal.

Indicator Diagrams and the Horse Power Formula.

The indicator diagram, as drawn by an indicator, is now recognized to be the foremost means of communication between the engine and the engineer. It tells in plain language, if properly interpreted, whether the valves of the engine are correctly and evenly set; it serves as a guide in all necessary valve adjustments in order to secure the best distribution of steam within the cylinder, thus securing the maximum economy and efficiency of the engine; the indicated power developed in the cylinder of an engine may be determined, also the quantity lost by the leakage of the valves, back pressure, too early release or incorrect adjustment of the valves; it indicates whether the steam ports and passages are adequate in size; and in connection with a feed water test, the economy with which an engine works may be determined.

As a large amount could be written about any one of the above subjects, it will be the especial object of this paper to show why it is that the indicator card gives the horse power of the engine generated in the cylinder and the explanation of the use of the horse power formula.

Work of any kind is the product of two factors: force and

displacement, or force multiplied by the distance through which that force acts. Now a force can be represented by a straight line and so can the displacement, and since an area is of two dimensions, it follows that work can be represented by an area. For a uniform force, the diagram of work is a rectangle; for a uniformly increasing or a uniformly decreasing force, the diagram will be triangular or trapezoidal in shape, and for a variable force, it will be an irregular figure. The shape of the diagram will, however, depend upon the manner in which the force varies with the displacement. A correct diagram must show by its area the amount of work

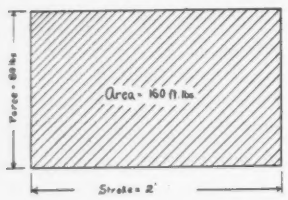


Fig. 1.

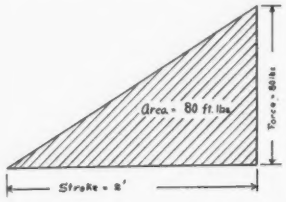


Fig. 2.

done and it must show to the eye the manner in which the force varies in magnitude during displacement.

For instance, in the cylinder of a pump, the boiler pressure usually acts throughout the stroke, so that the diagram taken from a pump will resemble a rectangle, as shown in Fig. 1. If, however, the piston was pushed forward by an elastic spring to the end of the stroke, the diagram would be a triangle, as shown in Fig. 2. As the unit of force is always taken as one pound and the unit of distance as one foot, the area of the diagram is given in foot pounds. In Fig. 1, if the height of the diagram represents 80 pounds and the length represents 2 feet, then the area of the diagram will represent 160 foot pounds. In Fig. 2, if the spring at the beginning behind the piston exerted a force of 80 pounds and if at the end it was zero and the length was equivalent to 2 feet, then the area of the triangle would represent $\frac{1}{2} \times 2 \times 80$ or 80 foot pounds, since the area of a triangle is equal to $\frac{1}{2}$ the product of the base times its altitude. The same rule holds true with an irregular figure, such as an indicator card. The outline of the card drawn by a pencil upon the indicator drum depends upon the variable pressure of steam in the cylinder acting upon the engine piston throughout one complete revolution of the engine, while the paper is travelling in a horizontal direction proportional to the piston travel and is the result of two movements at right angles to each other.

While the area of an indicator card cannot be obtained according to any fixed rule in mensuration, it can be found by dividing it into a number of small rectangles and trapezoids, as shown in Fig. 3, whose area can be found, or by means of a planimeter, which is an instrument which finds the area of any closed shaped figure by tracing its point around the perimeter. The result of either calculation is the area, which represents a certain number of foot pounds.

As an indicator card, by its area, represents the number of foot pounds done by the engine during the time that card was made, it is necessary to know how many cards are made in a certain time in order that it can be compared with some other engine or engines. This involves the term power or rate of doing work, and there is a unit of power just the same as there is a unit of measurement or unit of weight. The unit of power, adopted in this country, is the horse power, and was first introduced by Watt in estimating the power of his engines. It is the rate of doing work corresponding to 33,000 foot pounds in one minute. Therefore, if the number of revolutions of the engine be known, it is only necessary to multiply the area of one indicator card by the number of revolutions and divide by 33,000 to obtain the horse power of that end of the cylinder at the time the card was taken.

On account of the fact that the indicator diagram is drawn proportional to the stroke in length and proportional to the steam pressure in height, it is not necessary to find the number of foot pounds directly. For this reason, another method for finding the horse power is used since the length of stroke and therefore the length of card is always known and of fixed length. This method makes use of the mean height of the diagram. The mean height of any diagram can be obtained by dividing the area by the length. On an indictor diagram, since the height is drawn proportional to the steam pressure, according to the strength of the spring used, it is necessary to multiply the height in inches by the scale of the spring in order that the mean effective pressure can be found.

Many engine rooms do not possess a planimeter for finding the area of the card, so that the mean height is obtained as shown in Fig. 4. The length of the card is divided into a number of equal parts and vertical lines perpendicular to the atmospheric line drawn through the points of division. If the height of each of these lines be added together and divided by the number of lines, the result will give the mean height desired. As this often involves the addition of fractions, a still easier method is to mark them off, one after another, on a strip of paper and measure off in inches the distance between the two outside marks, and divide by the number of lines so marked off. The result will be the mean height. The mean height multiplied by the scale of the spring gives the mean effective pressure in pounds per square inch.

The formula $\frac{\text{PLAN}}{33{,}000}$ in which P = mean effective pressure in pounds per square inch, L = length of stroke in feet, A = effective area of the piston in square inches, and N = number of revolutions per minute, is then available for finding the

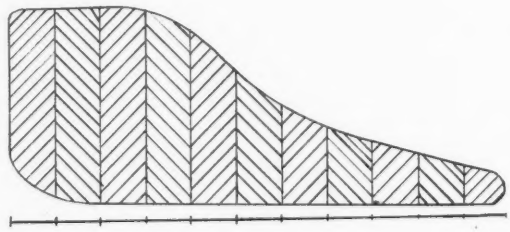


Fig. 3.

horse power. In finding the effective area of the piston, it is usually best, especially for accurate work, to measure the diameter of the cylinder while it is hot, and the effective area of the piston on the crank end is always the area of the piston less the area of the piston rod. The length of stroke can easily be measured by noting the travel of the crosshead, or it can be obtained by measuring the radius of the crank and multiplying by two.

It has been the experience of the writer that the value of

N is often misunderstood. In a single-acting engine, when only one card is necessary, there can be no doubt that the value of N is the number of revolutions per minute. In a double-acting engine, two cards are necessary to find the horse power. If the mean effective pressure of both ends be found and the mean taken, the value of N in the formula must be equal to the number of strokes, but if the horse power of each end is calculated separately and added together, then the number of revolutions must be used. If N is taken as the number of strokes per minute when calculating each end separately, then

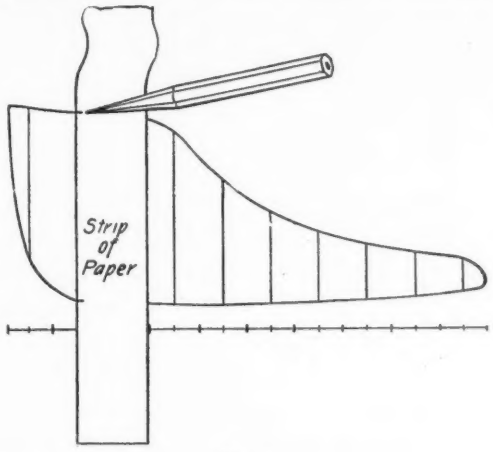


Fig. 4.

the horse power of each end when added together must be divided by two.

Probably the easiest method is to find the mean effective pressure for each end separately, add together and divide by 2, the value of N in the formula being taken as the number of strokes. As there is only one card taken for each revolution from each end of the cylinder, the value of N depends upon whether the value of P represents the mean effective pressure of one end or both ends.

Petroleum Briquettes for Fuel.

It is reported from Germany that a new process has been invented for manufacturing petroleum briquettes. The process consists of mixing petroleum with three other chemicals in the following proportions: Petroleum, 1 litre; soft soap, 150 grains; resin, 150 grains; caustic soda lye wash, 300 grains. This mixture is then heated and well shaken, after which it is allowed to solidify. This operation occupies about forty minutes. Care has to be observed to prevent the liquid from running over, and this is achieved by pouring a small quantity of soda into the vessel and shaking it well, until solidification is completed. The mixture is then run into briquette molds of the requisite size and these are then submitted to a furnace heat for ten or fifteen minutes. The briquettes are then set aside to cool, which occupies an hour or two, and then they are ready for use. If it is desired to make the briquettes more solid, this can be accomplished by the addition of sawdust or sand to the mixture. Experiments have demonstrated that these briquettes yield three times as much heat as ordinary coal; they are lighter in bulk and easier to carry; and what is more important, after consumption, there is very little ash or other residue.

STEAM AND OIL SEPARATORS.

Different Methods of Separation Employed in the Standard Types of Separators.

PART II.

The Simonds separator makes use of centrifugal force to perform its separation. The entering steam is made to take an easy spiral sweep, as shown in Fig. 11. The centrifugal force throws the water to the outside of the separator while the pitch of the spiral and gravity tend to hold it to the bottom from where it is drained off. The outlet pipe to the engine is high up so that only the inner cylinder of dry steam is allowed to enter it. The receiver is made of sufficient size to act as an accumulator for storing steam.

The Keystone separator depends upon the action of centrifugal force, as shown in Fig. 12. The steam is made to travel in a spiral, which throws the water to the outer circumference. The steam, being on the inside of the whirling mixture, enters the inside pipe abruptly through holes in its circumference, and then on to the engine. The water continues its spiral motion until the bottom of the separator is reached, when it is drained off.

In the Bushnell separator, Fig. 13, the steam and water meet a curved deflector without shock, the water being thrown down to the reservoir below out of contact with the steam. The steam passes around the edges of the deflector and makes a quick turn which throws any remaining moisture to the sides, down which it passes to the reservoir.

The Hine eliminator is shown in Fig. 14. It consists of a rough interior around which the steam is made to pass in a circuitous manner. The corrugations are so constructed that they carry off the water at a different angle from the course

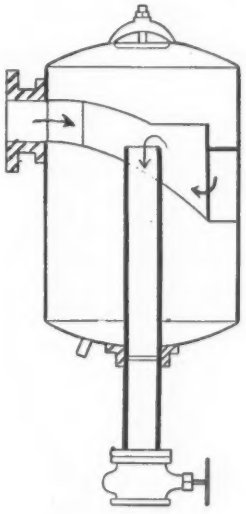


Fig. 11.

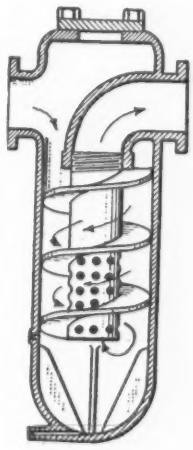


Fig. 12.

of the steam, so that any moisture or oil does not come in contact with the steam again. The water of condensation finds its way to the bottom and is drained off.

In the Sweets horizontal separator, shown in Fig. 15, the steam and water are allowed to come into contact with the lining of the shell through which water can freely flow, but on account of the direction of the perforations, it cannot flow back again. There is also provided a trough at the inner pipe

which catches and entrains any moisture which adheres to the circumference. As the steam makes three right angle turns, the water is thrown both outward and downward. The perforated cone at the bottom prevents the current of steam from picking up any water from the water chamber.

The Curtis separator belongs to the type that depend upon the baffle plate arrangement to perform the separation. Steam on its passage through the separator, as shown is Fig. 16, is sharply deflected downward and then sharply deflected upward. The steam accommodates itself to these changes of direction, but the water carried along with it continues onward instead of turning with the steam, and is projected against the faces of the deflectors and run down them to the bottom. The lower edges of the deflector plates are cut at an angle so that the steam will run down them until they touch the outside of the shell out of the current of the steam.

The Linstrom separator, as shown in Fig. 17, is specially designed to be placed inside of the boiler directly in line with the outlet pipe and prevents water from entering the steam pipe, it being used as a supplement to the separator near the engine, which takes care of the condensation in the steam pipe. The steam enters the small holes in the upper surface of the separator and the webs under each hole prevent the sudden and direct withdrawal of steam which is compelled to take a crooked path, and the water being separated in the usual way, flows back into the boiler through a suitable opening in the bottom which is connected to a pipe leading down below the water line of the boiler.

The action of the Mosher steam separator is due to centrifugal force, and the action of gravity. It consists of a worm or twisted plate which causes the steam, water and oil to whirl. The centrifugal force due to this whirl causes the water and heavier substances to be thrown to the wall of the separator

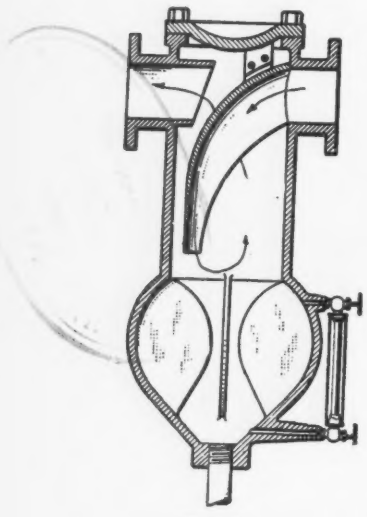


Fig. 13.

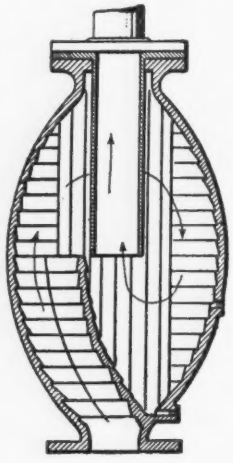


Fig. 14.

and at each revolution the water is separated by the edge of the blade and thrown down into the space below, as shown by the upper view of Fig. 18. The lower view shows its adaptability inside of a boiler. The condensed water then runs into the receiver and when placed inside a boiler is returned below the water level by means of a pipe.

The Kutztown Compound separator, shown in Fig. 19, consists of a series of plates so arranged as to make a complete separation of the water and steam before the latter leaves the boiler. The steam is made to travel around the plates which catch the moisture which runs back into the boiler by means of

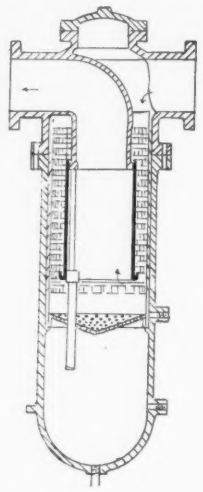


Fig. 15.

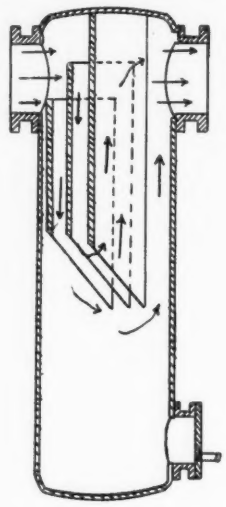


Fig. 16.

the small holes drilled in the plates. It takes the place of a dry pipe or steam dome and prevents a sudden lifting of water from the boiler.

The Potter separator is designed to be placed in the steam space of the boiler in place of the dry pipe. It consists of a number of layers of wire screen, through which the steam pipes on its way to the main steam pipe. The moisture in the steam is broken up by the first piece of gauze and still finer by the second and so on until it is completely atomized. The heat which is obtained by only a small amount of wire drawing is said to be sufficient to evaporate the minute particles of water and furnish dry steam.

The many purposes for which exhaust steam is used make it very important that not only should the water be eliminated, but also the oil. Oil in the steam follows the same general rules that apply to water and for this reason most of the above separators are used either for oil or water separators or both. One of the principal uses for exhaust steam is for heating, In using exhaust steam for this purpose, to obtain the maximum effect with a given amount of surface, the steam used must be dry, as the latent heat of vaporization is the largest percentage of the heat given out by the steam. This is lost in the water that is present, as it has already given up its latent heat elsewhere. A slight film of water on the surface of a pipe also renders the portion so covered to be less efficient, and where the quality of the steam varies greatly in the amount of water that it contains, irregularity of heating is to be expected. The presence of water in heating pipes is also a source of the hammering and snapping, which is not only disagreeable but destructive to joints. It is also important that the oil in the steam be eliminated. Heating with oil laden exhaust steam is uneconomical, as the system and radiators become covered with this oil which acts as a non-conductor and prevents the transference of heat that is desirable.

When the exhaust steam is used for feed water it is im-

portant that no oil should be introduced with it into the boiler. The effect of oil in a boiler is to cause overheating. The little particles of oil adhere to the inner surface of the boiler, making it impossible for the water to touch it and transfer the proper amount of heat. When these particles are numerous, they form a large surface exposed to direct contact with the intense heat which is not only inefficient but which becomes overheated, causing a bagging of the crown sheet or other detrimental effect.

Wherever possible, unless the piping be very short, the separator should be placed as close to the engine as possible, as it then not only takes care of the condensation in the pipes, but acts as a receiver to store up steam. The engine uses steam in large quantities at the beginning of each stroke until the point of cut-off is reached, after which it does not use any from the boiler until the next point of admission on the under end. That is, with steam cutting off at ¼ stroke, the engine demands steam from the boiler only 25 per cent. of the time, but when it does need it, it wants it quickly. The effect of this is to wire draw the steam at admission, especially if the steam pipe is too small, and to lessen the initial pressure owing to the friction of the steam in the pipe due to its enormous velocity. The effect of placing the receiver at the engine is to lessen these results. It acts as a reservoir to receive the steam from the boiler uniformly and give it to the engine as needed. This prevents the constant surging back and forth of the column of steam in the pipe, which as a result tends to make the pipe tremble, which often causes leakage and sometimes breakage.

The larger, therefore, the receiving portion of the separator is made, the greater storage capacity it has and the greater

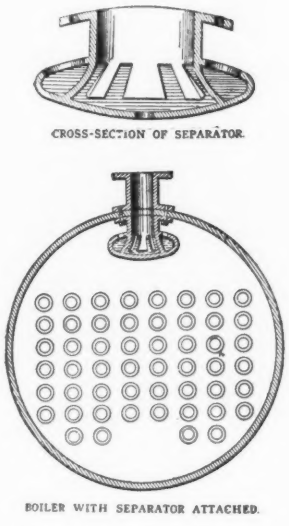


Fig. 17.

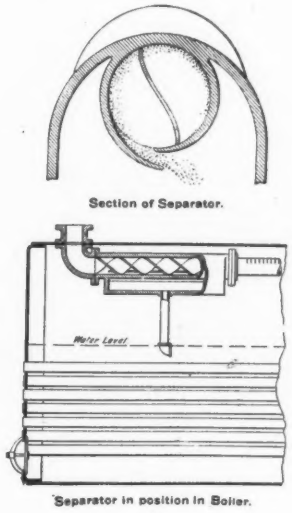


Fig. 18.

advantage is to be gained thereby, as it makes practical the use of smaller steam pipes than would otherwise be necessary for conveying the steam from the engine to the boiler; it provides large storage space for taking care of any large amount of water that might come over with the steam, giving the drainage apparatus time to carry off this excess of water; it corrects partly the ill effects that result from faulty piping and it prevents boilers from priming, due to an excessive demand of steam at short intervals.

When separators are used for removing the oil from a condensing system, they are placed in the main exhaust line between the engine and condenser, so that the condensation may be safely used as a part of the boiler feed supply or for other purposes where oil would be objectionable and when used between evaporators and their condensers, they prevent the

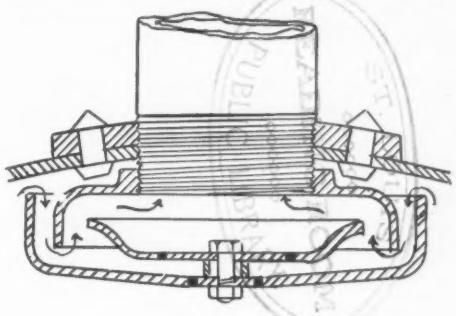


Fig. 19.

liquid or solid substances from being carried over into the condenser or lost in the condensing water. Separators are used in refrigerating plants to remove oil from the ammonia gas in order to prevent it from coating the internal surfaces and reducing the efficiency of the system.

While the many advantages of the separator have been enumerated, it must be remembered that unless properly designed, the friction of the steam through them will cause a drop in the initial pressure, but in well designed separators, as the area for the steam passages is made a number of times the area of the steam pipe, the velocity is sufficiently reduced as to make this a negligible quantity.

How to Calculate Speed.

To find the speed of a countershaft, if the revolutions of the main shaft and size pulleys are given: Multiply the revolutions of the main shaft by the diameter in inches of the pulley, and divide by the diameter in inches of the pulley on the countershaft; the quotient will be the number of revolutions.

Example.—What will be the speed of a countershaft with a 12-inch pulley, driven by a 30-inch pulley 180 revolutions per minute? $180 \times 30 \div 12 = 450$.

To find the size of a pulley required, if the number of revolutions and size of pulley on the main shaft are given: Multiply the diameter in inches of driving pulley by the revolutions of the main shaft, and divide by the speed required; the quotient will be the diameter in inches of the pulley.

Example.—What will be the diameter of a pulley to make a countershaft turn 450 revolutions per minute, driven by a 30-inch pulley 180 revolutions per minute? $180 \times 30 \div 450 =$ 12-inch pulley.

To find the size of a pulley for a main shaft if the speed of shafts and diameter of the pulley on the countershafts are given: Multiply the diameter in inches of pulley by speed of the countershaft, and divide by the revolutions of the main shaft; the quotient will be the diameter of the pulley.

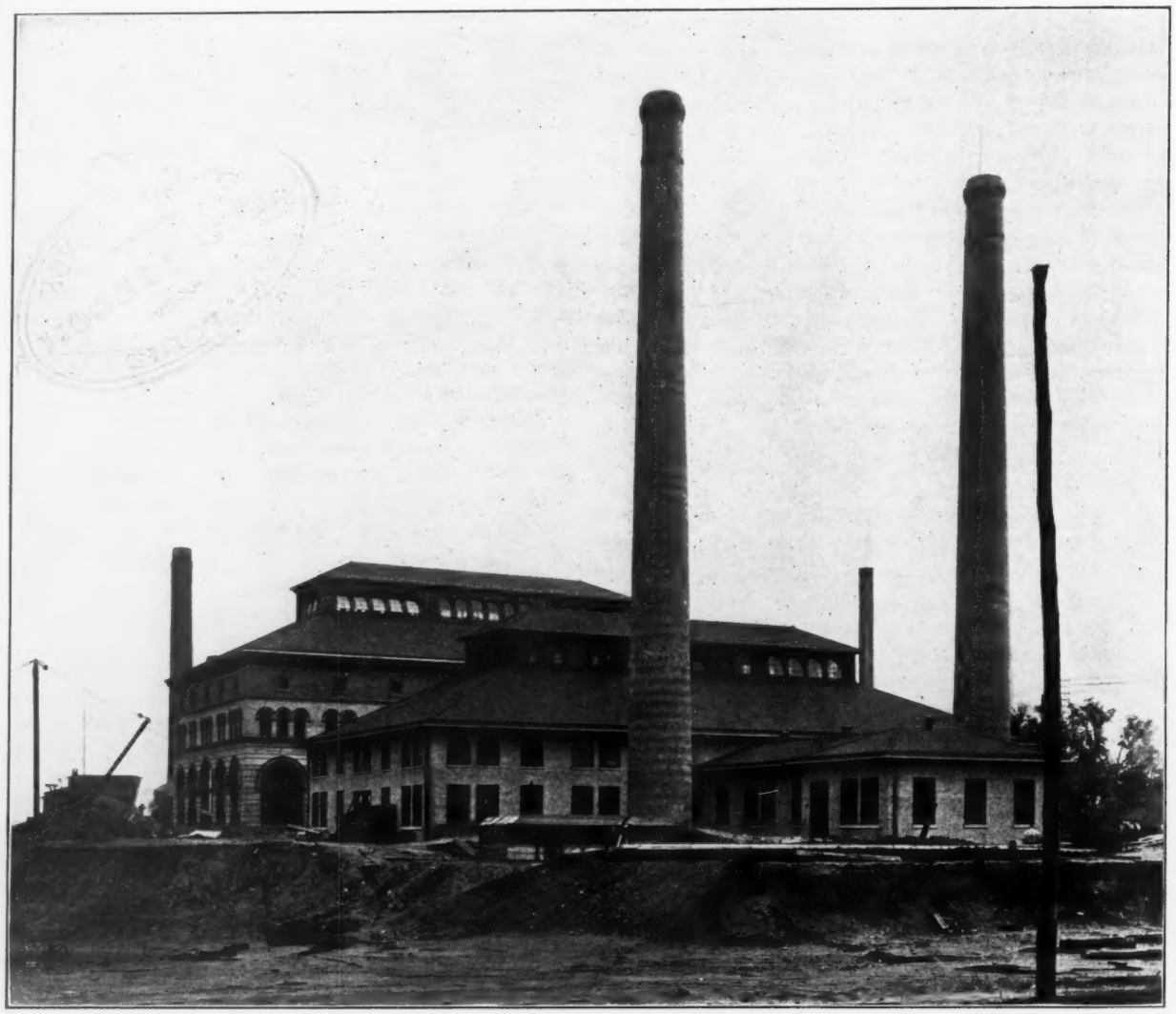
Example.—What will be the diameter of a pulley on a main shaft making 180 revolutions per minute to drive 12-inch pulley 450 revolutions per minute? $450 \times 12 \div 180 = 30$-inch pulley.

The Effect of Lightning on a Brick Chimney.

It is said of lightning that not only does it never strike in the same place twice, but when it does strike in different places, its results are usually different. This important phenomena of lightning is the discharge of electricity between one group of clouds and another, or between the clouds and the ground. That it can possess considerable force is illustrated by its effect upon the chimney of the Lardner Point pumping station, a picture of which is shown herewith.

the one that was damaged, what appears to be a lightning rod is only a stick which the masons left with a flag attached to celebrate its completion. The flag was ripped off the pole by the storm which damaged the chimney.

Upon examination of the accompanying cut, it will be seen that the crack in the chimney, caused by the lightning, extends down from the top about one-third the height, or about 50 feet. The picture does not show adequately the extent of the disaster. What appears to be a crack in the chimney is an opening in the masonry in some places from four to eight inches wide, and



Pumping Station at Torresdale, Pa. The centre stack was recently struck by lightning. The black irregular line represents an opening 4 to 8 inches wide extending through the chimney.

This pumping station building has recently only been finished and will be used in connection with the filter plant at Torresdale, Philadelphia. The building and chimneys are built of yellow pressed brick. The chimneys are about 15 feet in diameter at the base and 150 feet high. The chimney in the centre is the one that was struck by lightning. None of the chimneys of this plant contains lightning rods, as the engineers in charge of the plant do not favor their use on chimneys. The chimney to the right of the one which was struck appears to have a lightning rod on it but as it was finished later than when the lightning struck it, it knocked tons of brick and mortar to the ground below. When the lightning decended to the bottom of the break it seems to have spent its force, as the lower part of the chimney is untouched.

When lightning rods are put on any structure, their object is twofold: first, to draw away the electricity from the passing clouds and thus prevent the occurrence of a lightning discharge in the neighborhood; and secondly, when unable to do this, to receive and convey to earth the lightning flash without damage to the structure to which it is attached. The most

important part of a lightning conductor is the connection to earth. Dry earth is practically a non-conductor of electricity. Damp earth is a moderately good conductor and the problem therefore is to make a connection with a sufficient quantity of damp soil to take care of the discharge. A faulty earth connection makes a lightning conductor worse than useless and it is on this account that some engineers do not favor them on chimneys.

Heater Troubles. Too Hasty in Condemnation.

By C. W. Dunlap.

It is strange, yet true, how quick some engineers will fall down when the least thing happens in their engine room, yet in an emergency case, such as escaping steam, bursting of pipes, etc., they never flinch. Some time ago, an engineer friend of mine had the courage to drag one of his firemen the entire length of his fireroom, some 35 feet, to a place of safety, after the bursting of a tube in a large water-tube boiler, yet a few days ago when he could not maintain a satisfactory temperature of the feed water he sent straightway for the man that supplied the heater. I happened into the engine room while the heater man was there and listened very attentively to his arguments with the engineer. His first question to the engineer was: "What have you done to try to get the heater to heat the water to the temperature maintained previous to this supposed trouble?" "Why, nothing," says the engineer, "I took out a thermometer yesterday and tried the temperature of the water in the filtering chamber, and it showed only 131° F., so I sent for you." "Well!" said the heater man, "I am very much surprised at you, for you have such a nice plant and to think that you would not look for the source of the trouble sets me thinking. Now before we touch the heater," said the heater man, "I want to ask you a few questions. Has it occurred to you at any time that perhaps your heater was not getting enough steam from the exhausts of the auxiliaries to heat the water?" "I don't really know," said the engineer, "I never touched the back-pressure valve, the weight is in the same place on the lever that your man put it when he first tested the heater." "Well," said the heater man, "let's look at it!" And, sure enough, the back-pressure valve was caught on a piece of packing which had lodged in between the wings of the valve and the body. By lifting the lever a few times, this was soon dislocated and in a short time the water was warmer, but not enough to satisfy the heater man. His next question to the engineer was: "How do you regulate the supply of water to the heater?" "I use all the returns from the heating system and that automatic float valve there supplies what is lost by waste and evaporation." The heater man told the engineer to put his ear up to the automatic float valve and listen to the water rushing through the pipe, and asked the engineer if he knew what caused it and he said that he didn't, unless it was leaking. "Well, it is not leaking," said the heater man, placing his hand on the valve lever, and pressing it down. "See, the float is working, all right, look at your water-glass—is the water all right in it?" "Yes," said the engineer, "the glass is nearly full." "I don't believe it," said the heater man, and opening the glass drip valve, sure enough both ends of the glass were plugged with sediment. This was hastily cleaned out by the engineer, who began to realize that he had a fellow to deal with that knew his business.

As soon as the glass was free, the heater man closed the water valve, and straightway the water started to drop down in the glass until he had to open the water valve again to keep up the water in the heater. "Well, what do you think is the matter now?" said the heater man to the engineer. "Well, I don't really know, unless possibly we are not getting all the returns or something of that sort." "It might be that," said the heater man, "but you put your hand on that waste pipe from the bottom of the filtering chamber to the sewer and see if that valve ain't leaking." The engineer put his hand on the pipe and sure enough the valve was leaking badly. In putting in a new valve, the piping was so arranged that the drain could be examined any time for a leaky waste valve. Well, this opening stopped, the water was much hotter but the heater man was not satisfied yet, so he said to the engineer: "Now, we have made several alterations, yet we don't get the temperature; what do you think we had better do next?" "I don't know," said the engineer, "unless we increase the back pressure." "Why should we do that?" asked the heater man. "Haven't you recently increased your boiler pressure 15 pounds? If so, surely you don't need to increase the back pressure on the heater?" "Let me see," said the heater man, "disconnect the overflow pipe and then we can see just how that overflow valve is working. The pipe was soon apart and sure enough it divulged another lot of trouble. The overflow valve-stem was gummed up and valve was leaking badly, the float attachment refused to operate the valve.

The result was that the steam which should have remained in the heater to heat the water found its way out through the leaking overflow valve. It took but a short time to grind in the overflow valve, clean and repack the stem, and after thoroughly cleaning out the entire piping arrangement to the float tank, and adjusting the automatic overflow valve, the heater was filled, and in a short time the temperature of the feed water was increased to 207° F. The engineer was a wiser man, and hereafter he will do some thinking before he condemns a piece of machinery.

Cements used for Concealing Blow-Holes.

The foundryman who turns out badly blown castings does not always discard it, but conceals the holes with the aid of one of the special cements sold for the purpose. It is said of these cements that they set in 24 hours, but continue to harden indefinitely and that as they possess the same coefficient of expansion as iron, they contract and expand in the same ratio as the iron, so that there is no fear of their working loose. These plugs may be painted and polished or even filed without becoming apparent.

Wireless Telegraphy in Canada.

It is stated that Marconi interests in Canada have successfully completed negotiations with the Canadian government for the establishment of a system of seven wireless stations between Montreal and the Straits of Belle Isle, as an aid to navigation. At least four of the stations must be in operation before the end of August, and the whole system completed before the opening of navigation next year. All passenger ships travelling in these waters will be equipped with signaling and receiving apparatus.

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The Practical Engineer is devoted to the economical generation and utilization of power for the industries.

Articles upon subjects of interest to engineers, will always receive our very careful attention.

The little things are often most valuable, therefore, we especially solicit short articles on the small problems met with in daily practice. When illustrations are desirable a pencil sketch is sufficient.

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Side Talks with the Editor.

To the very many old readers of this paper who have been constant subscribers from its beginning and to the six or seven thousand new readers who have joined our ranks during the past year, this article is written. It is to you the paper is sent and for you the paper is written and while we feel that the very large increasing circulation is an indication of its popularity, yet we would like to keep constantly in touch with you as regards the kind of articles that go into the paper. If you think of any subject which would be of interest to your fellow-engineers, write in and suggest it or if there are any articles which you think do not interest you, tell us about it. We invite criticism.

It is the policy of this paper to put in only such articles as will be of educational value and to put it in in such a way that it can be understood. Our columns have no use for mathematical theories written by those who have never run an engine, or of elaborate designs of machinery by those who do not know a file from a hacksaw. Our aim is to publish only such articles as we feel will be of use to the engineer in his daily work around the power plant and which will help him to be of more use to his employer and have a greater earning power in himself.

Do not hesitate to send in questions about any subject of interest; only remember that they cannot all be answered at once. Neither can all the letters sent in be published the next month. If you do not hear from us for some time, remember that our mail is often heavy and sometimes the simplest question is hardest to answer or there is not space for publishing either the letter or the answer. Up to the present time, there has not been a letter or a question sent in that has not received our careful attention.

Finally, we want to please you and because we are growing so rapidly we wish to make it plain that your relationship in our happy family has not changed one bit and we hope with our constantly increasing facilities to make this relationship still closer.

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The Horse Power Formula.

There is probably no one thing that is of greater value to the engineering world than the various formulas given for the purpose of calculating results of various kinds quickly and accurately. In practice they consist of two kinds: those that are absolutely correct and those that are empirical. An empirical formula is one which when used will approximately give the result desired. It admits of no discussion because it has usually been deduced by noting the results of a test or experiment and then working backward to get quantities which when combined will give the results desired. They are more or less relationships which have been found to exist accidentally but which do not suggest or imply the explanation or cause of the production of those quantities. They are usually tentative and often form stages in the discovery of more accurate laws.

The greater majority of formulas are, fortunately, based upon accurate laws and when the proper quantities of the formula are substituted, they give a result that is absolutely correct. The horse power formula is one of these. If the mean effective pressure of the engine, the piston speed per minute and the area of the piston be known accurately, the horse power of the engine, for that particular moment under consideration, will be known beyond a question of doubt.

Next in importance to the formulas themselves is the correct understanding of the units employed in those formulas. These can usually only be understood fully by examining the method by means of which they were derived. Take the horse power formula again. There is no formula that gives the beginner of the study of engineering such trouble as this, because some authorities say take N as the number of revolutions per minute, others take N as the number of strokes per minute and others neglect the use of N altogether and use the combined quantity LN as the piston speed in feed per minute.

With these apparently different quantities to choose from, it is no wonder that the engineer begins to doubt the results that he has calculated. The fact is they are all of them correct, it being a question entirely of the correct understanding of the

formula or the way it was derived. In another column of this issue will be found an article pertaining to this subject and which should clearly set forth some of these fundamental and important principles.

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What Would You Do?

There is probably no question that is more often asked the engineer, both in examinations or in society meetings, than what should be done in cases of emergency. It is also a question that is continually rehearsed to one's self whenever the possibility of an accident is considered. The successful weathering of an accident in the boiler room or engine room has been the making or breaking of the reputation of an engineer in the estimation of his employer. The case of the recent Baltimore fire has brought up the question: "What should be done to save the boilers in case the building which contained them should be entirely burned?" At a recent meeting of engineers, this question was asked and there were as many different opinions as there were men in the room. The fact is that some of the boilers that went through this fire were saved and others were entirely destroyed, due to the foresight of the man in charge.

An emergency of a serious character consists in the unexpected discovery that the pressure in the boiler is very much higher than it ought to be. This may be due to the fact that the steam gauge is badly lighted and cannot be seen from the boiler room floor, or it may be that owing to accumulated dirt or age of the gauge, that the attendant has made some mistake in reading it. Another cause that may increase the boiler pressure is the sudden throwing off of the load so that the pressure will run up rapidly. Of course, a watchful attendant would not allow this thing to happen or the damper regulator would take off the draft, or the boiler would relieve itself through the safety valve. If, however, such a thing would happen, what would you do? It may seem a very trivial question to ask, but the fact is that sometimes there is no damper regulator, and the safety valve does stick fast and very serious results have happened when the wrong thing has been done to lower the pressure in the haste that is usually incident to such a discovery.

Another very common emergency consists in the water level being too high or too low. The attendant may suddenly discover that no water can be seen in the glass. This may signify that the water is too high or too low. If too high, that part of the boiler that should be used for steam space becomes filled with water and while this will not hurt the boiler, there is the likelihood of the engine getting a "dose" of water from this cause with its well-known detrimental effects. If the water is too low, some part of the boiler is likely to become injured from overheating. This has been the cause of more boiler explosions than perhaps any other cause. In case the water cannot be seen in the glass or if the water is too high or too low, what would you do?

These are only a few of the emergencies that may be met with in the lifetime of an engineer. Perhaps they never will happen but apparatus like human beings may fail in times of emergencies. It is here that the engineer must step in and often at the risk of his life meet the emergency which the apparatus has failed to meet. It is the duty of every engineer to so inspect and keep in repair all parts of the apparatus in connection with a steam plant as to render the liability of an accident a minimum, but if only for the sake of argument, what, if any of the above should happen, would you do?

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The Value of Good Inspections.

It is very unfortunate that, as soon as politics plays an important part with the appointment of inspectors in any department of the public business, the efficiency of the inspectors so appointed is very small. It would seem natural that just the reverse should be true, because any employee will naturally look after the interests of his employer, but in the case of public service it is the exception rather than the rule to find the inspector thinking more about the public who pay him than the gaining of a few votes for which he was appointed. From time to time, loss of life through neglect of the plainest laws and other appalling consequences have been made possible through the corruption or inefficiency of inspectors.

The investigation of the Chicago theatre fire made it evident that had the inspectors been fairly efficient in their duties, there would have been no horrible death for the six hundred victims. The jury in the case of the accident to the large excursion steamboat which burned in New York harbor with the resulting loss of over one thousand lives, found that deliberate carelessness of the inspectors made possible the appalling disaster. Many boiler explosions have been due to imperfect inspections with the usual result that the engineer or fireman must usually bear the brunt of the blame whether he survives the accident or not. In the case of the accident to the steamboat above mentioned, it was reported for a few days after the accident that the engineer started the fire and then disappeared, when the fact was he stuck at his post through the fiery ordeal until the boat was beached.

Boiler explosions can be prevented if the proper inspections are made. This has led some of the largest insurance companies in this country to take up this form of insurance. They have the best inspectors that it is possible to get, who inspect the boilers at stated periods and who only give a certificate when they are satisfied that the boiler has the proper factor of safety and the required safety devices. If public inspectors were as efficient as this private corps of men, the public would be amply protected and nothing would be heard of the crusade against public inspectors, who are the last check to see that the laws are not neglected, which laws are intended to protect the lives and property of the people.

An Immense Water Wheel at a Tin-Plate Works in South Wales.

By Frank C. Perkins.

The accompanying illustration on the cover and drawing Fig. 1, show the details of construction and installation of a Pelton water wheel having a circumference of 63 feet and a diameter of about 20 feet, recently placed in operation at Cwm Avon, in South Wales, a short distance from Port Talbot. Water wheels are not used very generally in rolling mill practice and this installation in the large tin mill of the Copper Miners' Tin-plate Company, Ltd., is of special interest. At this plant, about 5000 boxes of tin-plate are produced each week, using about 400,000 lbs. of tin bars made from steel produced in Siemens Open Hearth Furnaces. At this plant both steam and hydraulic power are used, for a number of years 4 overshot water wheels having given excellent satisfaction working one over the other and developing over 200 H. P. The water was supplied from a mountain stream which provided a head of about 100 feet. The 4 overshot wheels were replaced recently by 2 Pelton wheels one of which is shown in the accompanying illustration and drawing. The water is conducted to the wheels through a steel pipe 39 inches in diameter, with bends having cast iron joints packed with lead. Kimberly flanged joints are employed and the plates are ¼ inch in thickness. About 100 feet above the wheel level the water is collected in a dam on the side of the hill and conducted to the water wheels through the main above mentioned, which is about 630 yards in length. This main was installed by T. Pigott & Co., Ltd., of Birmingham, and near the first wheel a branch pipe 2¼ feet in diameter is installed, supplying water to a second wheel located on the other side of the rolling mill. A throttle valve is provided close to the discharge nozzle as

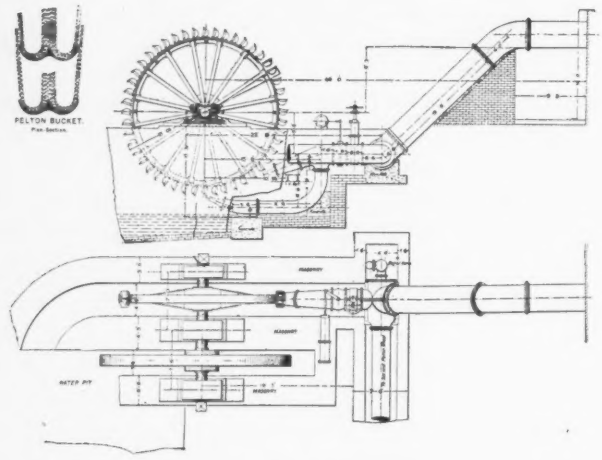

Fig. 1.

shown in the illustration and drawing, this valve turning on a vertical axis. It is operated by hydraulic cylinder, which is controlled by a small Pickering governor, the cylinder being supplied with water by a small pipe at about 40 lbs. per square inch. The rim and buckets of each wheel weigh about 10,000 lbs., while the complete water wheel weighs about 22,000 lbs. It was found necessary to utilize with this water wheel an immense fly wheel which weighs 100,000 lbs. Each Pelton wheel was designed to develop over 200 H. P., the water available a greater portion of the time being capable of supplying from 400 to 500 H. P. by the use of the two water wheels.

The nozzles first employed were designed to give 175 to 200 H. P. but on account of the blocking of the head race with an accumulation of rubbish there was not a sufficient supply of water, and nozzles were provided for developing about 150 H. P. The speed of these Pelton water wheels which have a diameter of 20 feet at the centre line of the buckets, is theoretically 36 revolutions per minute. Each wheel is provided with two jets. The buckets are of cast iron, while the arms are of wrought iron and the segments onto which the buckets are bolted are of cast iron. The net working fall is 98 feet while the gross fall is 106 feet. These Pelton wheels were constructed by Messrs. Gilkes & Co., of Kendal, Eng., and are each enclosed in a wooden housing. The rolls in this mill are a trifle over 1½ feet in diameter but the resistance is not as great as in back sheet mills as the plates are short in tin mills, while in black sheet mills plates as large as 4 feet by 9 feet are rolled.

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Advertising and Export Business.

During the summer of 1901, the writer of this, on a business trip to Europe, landed in Cuxhaven, which is the first landing port of the Hamburg-American Line Steamers bound for Hamburg. The wharves and railway station in Cuxhaven, since then, have been re-built, but, at that time, the landing wharf was connected with the old railway station by a long covered passage. The station end of this passage was a blank wall, the entire surface of which was entirely covered with the—on this side—well-known advertisement of "Quaker Oats."

This particular advertisement, in the writer's opinion, had a better position than any other advertisement which he has ever seen, as it was bound to make a lasting impression on the thousands of men, women and children whose minds and eyes had been relieved from looking at any and all kinds of advertisements for the period of an ocean voyage.

The European traveler will find familiar signs advertising American specialties not only in every large city but in many out-of-the-way corners, and these specialties which are advertised extensively cannot help but do a profitable business, as the mind of the average European responds readily to good advertising.

In England especially, a number of well located signs advertising Lord's Boiler Compounds can be seen. The manufacturers of these compounds, while they have numerous agencies established on the continent, have made a special effort during the past few years to gain a strong foothold for business in all English-speaking countries. In England and Scotland, several agencies have been established, and, while the undertaking has been expensive, the volume of business secured has been sufficient to prove the undertaking a profitable one.

A business once established in England will, naturally, extend to its colonies, and the Geo. W. Lord Company, manufacturers of Lord's Boiler Compounds, found it advisable to open offices in Australia as well as Madras, India. A great deal of advertising is done by each of these branch offices, a sample of which reached us from Madras, India, recently.

This particular advertisement was designed to be sent out

by mail and consisted of a well-printed East Indian scene, which we are herewith reproducing. The scene represents a photograph of a large shipment of Lord's Boiler Compounds arriving in Madras and being transported from the wharf to warehouses.

Particular attention is called to the mode of transportation, which is peculiar to the Madras presidency. It appears that

each two-wheeled cart is handled by three men, two of them managing the front end of the vehicle while one of them pushes on behind, usually with his head.

The mere fact that a specialty like boiler compound can establish a profitable business in foreign lands should be proof to the average American manufacturer that the world can be made his market.

V. O. Lawrence.

The Choice of a Steam Plant. With Special Reference to American Electric Power Installation.

Mr. George H. Barrus, who is widely known as an engineer and who is well qualified to speak on the above subject, has recently presented his views in the July number of *Cassier's Magazine* as regards the selection of an up-to-date power plant.

Steam Turbine.

He first takes up this problem as follows: Interest in the steam plant, and in the choice of engines and boilers for electric power generation has been widely increased by the introduction of the steam turbine, and there is no department of engineering which is receiving more attention at the present time on this account than that of steam engineering. The subject has attracted more notice than ever during the past year and particularly on account of the development of the Curtis turbine.

No one can now discuss matters regarding the selection of a steam plant, especially in electrical circles, without becoming aware that the steam turbine has obtained a strong foothold, and it must be considered along with the various kinds of reciprocating engines, as one of the sources of steam power from which to make a selection. In this connection it is significant, as showing the trend of engineering thought and development, that one of the largest and most widely-known builders of reciprocating engines has recently embarked in the turbine business, and that there are no less than four types of turbines on the market, made by responsible firms.

Until recently, engineers familiar with reciprocating engines only, had great doubt as to the ability of the steam turbine to compete with a reciprocating engine in the matter of steam economy; and there are many who still cling to the belief that the turbine principle must be a wasteful method of generating power. Reports of late investigations on different kinds of turbines, made by different engineers who are wholly unbiased, leave little room for doubt, however, that turbines in their latest and best forms are not only far from being wasteful, but, as a matter of fact, their economy of steam consumption is equal, if not superior, to that of the best classes of reciprocating engines in common use in electric power stations.

There are numerous advantages possessed by the steam turbine which are exceedingly attractive to the purchaser of a steam plant, and to the operator as well, and now that the turbine business has reached a stage of successful development, it is not surprising that the turbine manufacturers are favored with a large amount of business. At the same time, there are points about the turbine which are less attractive than those noted, and these make the engineer question what the ultimate status of the machine will be after it has been subjected to the wear and tear of ordinary electric power plant service.

It must be conceded that the turbine is still in what may properly be termed the experimental stage, although giving promise of an excellent future, and it would be unwise, if not impossible in a popular discussion of the subject, such as may be attempted in this article, to make a comparison of the different makes, or to offer any suggestions as to matters which should govern the choice of a turbine, in case the purchaser of a plant should decide upon this form of motive power. The purchaser himself is the only one who can settle this question, after having made a careful examination of the present status of the different types presented for a choice.

The Reciprocating Engine.

In reference to the choosing of a reciprocating engine, Mr. Barrus is more explicit and not so evasive. He says that in the matter of choosing a reciprocating engine for an electric power plant, it is noteworthy that in nearly all of the larger and more important electric plants which have recently been installed in the United States, the engines adopted are those of the well-known Corliss type. The fact is notable because the character of the motive power in these plants has been decided upon only after the most searching examination, in which the subject is studied in all its bearings and viewed from every standpoint. It is to be noticed also that not only in the newer and more modern stations, but also in the older plants of larger sizes, the Corliss engine is the most widely used. It is probably not too much to say that in the larger stations there are a greater number of these engines driving electrical generators than of all other kinds of engines combined.

The features which distinguish the Corliss engine from engines of other types are the form, arrangement, and mode of operation of the valves. If this engine is more popular, therefore, than other engines, the reason lies primarily in the popularity and success of the Corliss valves and of the mechanism operating them, rather than in any other particular.

Corliss valves have many advantages which justify their excellent record. One of the advantages which is greatly appreciated by the operating engineer is the accessibility of the valves for examination and repair. Being cylindrical in shape and lying in a cylindrical chest of small diameter, the bonnets

which cover the ends are of small area. Indeed, they are so small that four bolts suffice to hold one in place. To uncover the chest for the purpose of removing and examining the valve, it is necessary, therefore, to remove only four bolts, and this can be done not only with the greatest ease, but with the least expenditure of time. Another thing which adds to the ease of removal is that the valve is withdrawn from the chest endwise through the rear opening, and the connection between the driving end of the valve and the mechanism is such that the removal takes place without disturbing the mechanism in the least.

Accessibility in an engine valve is of little avail, however, unless the valve and its seat can be easily repaired. The Corliss valve is not only accessible, but its cylindrical form enables it to be most readily turned in the lathe and refitted when it becomes worn. The seat, being also cylindrical, is most easily rebored when the wear of the surface makes it necessary.

Another advantage of the Corliss valve is its durability and its tendency to maintain a steam tight condition in service. The valves have considerable lap, and for this reason the wear of the lapping surface occurs at a slow rate, and excessive leakage appears only after a long period of service. The use of independent steam and exhaust valves, the location of the exhaust ports and valves in horizontal cylinders at the bottom where best drained, the simplicity and accessibility of the valve mechanism, and the ease with which the mechanism is adjusted, are added advantages, which, one and all, have done their part in making the Corliss engine popular among engineers and most serviceable in practice.

The mechanical features noted are not the only ones which distinguish the Corliss engine and give it high standing. It is also most economical in the consumption of steam, and this advantage is always recognized as one of the greatest importance. The economy realized in operation is the direct result of the notable points of design which mark the Corliss construction. One of these, which takes a leading place, relates to the efficiency of the valve mechanism and releasing gear. These operate in such a manner as to secure a highly-effective distribution of the steam; that is, the admission, cut-off, release, exhaust, and compression of the steam in its passage through the cylinder are made to take place at the proper times to secure the most economical work. That the distribution is well carried out is shown by the form of the indicator diagrams taken from the Corliss engine. These present such excellent features as to leave little room for improvement.

The design of the Corliss valve and its location close to the bore of the cylinder, as well as near to the end of the stroke, reduce the clearance passages to small volume, and furnish another reason for the economy of the engine. Still further reason for economy is the fact, already noted, that the form of the valve is favorable to tightness, and, not only this, but to a maintained tight condition for long periods. Excellent steam distribution and small clearances are of little avail in securing boiler engineering, as well as in the matter of engines, carries much weight. One of the first large electric power stations of any note installed in the United States—the Albany Street Power House of the Boston Elevated Street Railway Company,—built about twenty years ago under the engineering supervision of Mr. F. S. Pearson, adopted the horizontal water-tube boiler of the Babcock and Wilcox make. Four or five years ago, when the same engineer designed the Metropolitan Railway Company's power station in the city of New York, Babcock and Wilcox boilers were again adopted. In the Manhattan Railway Company's station at Seventy-fourth Street and East River, New York, which began operations two or more years ago, no less than 32,000 H. P. of these boilers are in use under the one roof. Other large stations recently erected, and some in process of installation, to say nothing of many smaller plants, have adopted boilers of similar make.

One of the latest designs of the Corliss engine which has been adapted to electric work, where large power is required, consists in the use of a pair of engines, each of which has two cylinders, one being horizontal and one vertical, working on the same crank pin. In these engines, which are of the compound type, the high-pressure cylinders are those which are horizontal, and the low-pressure cylinders, being the larger, are the ones placed vertically. This arrangement is especially suited to electric generators, because of the uniformity of the rotation produced and the consequent uniformity of the current.

The impulses due to the working of the steam are distributed in eight parts about the circumference of the shaft, and produce an almost continuous propelling force, whereas in the simple engine, there are only two impulses per revolution and the momentum of the fly wheel and of the rotating parts of the generator is depended upon to keep up the speed while the crank passes the two dead points. Uniformity of rotation is of special advantage in alternating current work where a number of engines and generators are required to run in parallel.

The compound condensing engine is a type that is now almost universally selected for large central stations. Between this and the triple or quadruple expansion engine, at existing pressures, there is little choice on the ground of economy, and the greater simplicity of the former is an advantage which easily gives the compound engine first place. This class of engines requires no unusually high grade of talent for its successful operation and it furnishes a motive power which can in all respects be depended upon.

Comparatively few modern engines, even of the larger sizes, are steam jacketed, as the increased economy due to jacketing has often been found so small as to hardly justify the necessary increase of cost and complication. Reheating receivers are in frequent use, being chiefly beneficial in producing a greater amount of power in the low-pressure cylinder, and thereby adding to the capacity of the entire engine.

Jet condensers with independent air pumps, either steam-driven or electrically-driven, are the most popular, and the loss of steam due to using the steam-driven type is largely prevented by passing the exhaust steam through a heater and utilizing it for heating the feed-water for the boilers. Superheated steam is being introduced in electric power plants to some extent, but the question of its desirability and economy as to coal consumption has not been proved with that degree of satisfaction which is convincing to all steam users.

The Boiler.

In connection with this subject, Mr. Barrus is very partial to one type. He says, turning from the engine question to that of the selection of boilers for electric plants, reference may again be made to what has been successfully accomplished by some of the leading power stations, for their practice into electric work is not found in any one conspicuous merit, but, as in so many other successful appliances, it must be attributed to the "all around" satisfaction which the boiler gives in ser-

vice, and the fact that it successfully meets the varied requirements of electric power stations.

In the matter of withstanding the high pressures which the steam engine practice of the day demands, there is little question in the mind of either the owner or the engineer that this boiler has the highest degree of safety. The largest shell which is commonly exposed to pressure is only 42 inches in diameter, this being the steam drum, and no difficulty exists in making it of ample strength. What is of greater importance, this shell, being removed from the direct action of furnace heat, is free from the special deterioration to which boilers are subject which have riveted plates exposed to the fire; and the need of reducing the limit of safe pressure as the boiler grows old does not exist to that extent which is experienced in externally-fired shell boilers.

The boiler in question is of simple design and construction, and there are no points about it which are not readily comprehended by the ordinary fireman and engineer. Absence of complication is of the greatest importance where such rough usage occurs as that going on in connection with boiler operation. In the care and daily handling of the boiler, it does not require to be favored, for it responds to any demands made upon it, however strong the draft and however much the fires are forced. When called upon to do so, it develops far beyond its rated capacity in power. The area of the surface at the water line is so large that no unusual attention to the supply of feed water is required, and the water-tender has an easy task in avoiding either high or low water.

Every necessary provision exists for keeping the heating surfaces free either of soot or of scale. The former is accomplished by blowing the exterior of the tubes with a steam jet, and the latter, by scraping or otherwise cleaning the interior. When the tubes wear out, they can easily be replaced with new ones, and the feature of easy repair in this respect is one of the strong points appealing to the operating engineer.

The tendency in the design of modern power stations is in the direction of using large-sized boiler units, and the boiler under consideration meets the demand. Units of 500 H. P. are widely employed, this size being about as large as it is convenient to use with the ordinary arrangement of grates, which become more and more unwieldly as the size increases.

No boilers in the large modern power stations are thought to be complete unless fitted with automatic stokers and coal handling machinery. When the stoker is of good design and properly attended, it not only saves fuel, but if used in connection with coal conveyors, it also saves a part of the boiler room force of firemen and laborers. In large stations, where the problem of labor is apt to be a serious matter, such aids are not only desirable but well-nigh indispensable.

Another adjunct to the boiler plant which is found in most of the large central stations is the apparatus commonly called an "economizer," placed in the chimney flue, for heating the feed water. The utility of the economizer depends, to some extent, on the temperature to which the water is first raised by the drips and the steam exhausted from the auxiliaries. Under the most unfavorable conditions, however, the advantage derived from recovering the waste heat of the gases is sufficient to make a considerable saving of fuel, and the money value of the saving represents a profitable return on the investment, except in localities where low priced coals are available.

In closing this article, the writer would not have it understood that because the particular types of reciprocating engine and water-tube boiler named are so popular and successful for electric work, they should necessarily be selected by the purchaser of a plant if he would insure satisfactory results. The desirability of other types of boilers and engines cannot thus be underrated. The fact is that many electric plants are in successful operation in which the engines have not the least resemblance to a Corliss design and the boilers are of such different types from the horizontal water-tube class that they would hardly be recognized by a layman as being designed for the same purpose. Just what engines and boilers and various appurtenances which go to make up a complete plant, should be selected in any particular case can be decided only after all the circumstances are fully considered.

Rule for Ascertaining the Safe Working Pressure of a Cylindrical Boiler.

The Hartford Inspection Company give the following rule for finding the safe working pressure of a cylindrical boiler: Multiply the tensile strength of the iron or the steel by the thickness of the plate. Then multiply this product by the efficiency of the joint, and divide the result by the radius or half the diameter of the boiler. This gives the bursting pressure and this result divided by the factor of safety gives the working pressure. The factor of safety generally adopted is 5.

The strength of a properly proportioned single riveted joint is 56 to 60 per cent. of the total strength of the plate. A properly proportioned double riveted joint 71 to 75 per cent. A properly proportioned triple riveted joint with inside and outside welt strips, 85 per cent. to 87½ per cent.

This rule may be expressed as follows:

$$\text{Safe working pressure} = \frac{\text{tensile strength} \times \text{thickness} \times \text{efficiency of joint}}{\text{radius} \times \text{factor of safety.}}$$

For example: What is the safe working pressure of a boiler 60 inches in diameter constructed of steel; plates ⅜-inch thick, with tensile strength 58,000 pounds per square inch; longitudinal joint double riveted, having an efficiency of 70 per cent. of the solid plate; factor of safety? According to the formula,

$$\text{Safe pressure} = \frac{58{,}000 \times .375 \times .70}{30 \times 5} = 101.5 \text{ pounds}$$

This rule assumes that the heads of the boiler are well braced. The strain or load on any brace should not exceed 6500 pounds per square inch. If there are no welds in the braces, 7500 pounds may be allowed.

Wood as Fuel.

In comparing the heating values of wood and coal, it has been found that 2½ pounds of pine wood are equivalent to one pound of coal. This means that the weight of wood which must be burned on each square foot of grate surface will equal 2½ times the weight of coal required in order to obtain the same amount of heat.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

Opening and Closing Valves.

EDITOR THE PRACTICAL ENGINEER:

In the July issue of your paper, Mr. Wakeman scores the writer on a statement made in the June issue in my article, "As Things Are Often Done," for condemning the use of a wrench for additional leverage on the valve wheel to make a valve steam or water tight. The writer is quite severely criticised for condemning the use of the wrench on the valve by Mr. Wakeman. It must pinch hard, as he takes it rather so.

The writer does not hesitate to come out and say again, that I still condemn, regardless of who advocates it or who makes a practice of the same, and still claim, as I did in the former article, that it is absolutely wrong; and it shows very poor judgment on part of any person who puts such a crude system into practice.

Any person who makes use of such practice is either careless or else don't know any different, for if the valves were in good condition no wrench is needed.

The writer has over 100 valves in his charge, ranging from 1 inch up to 7 inches on steam and water pipes and has never had to make use of a wrench on any of them to get them steam or water tight, and none of us are "Sandows" on this plant either. All valves have a wheel in proportion to the size of the valve and amply large to make any valve steam or water tight, if they are in the condition they should be, and, if always handled intelligently from the time they are first put on, but, if they are abused by careless usage or through ignorance of proper care, we must expect to have valves that require strength and muscle to get them tight.

If a valve cannot be opened or closed without using the wrench it requires attention and should have it, but if it does not get it then, the party in charge has no excuse and it goes to show neglect on his part.

Quite a number have mentioned Mr. Wakeman's article since they read it and some are much surprised at the stand he has taken in this matter, and, quite a few of the young men in the engineering business in this vicinity are wondering which is right, as they claim they were always taught differently. I have always regarded Mr. Wakeman as one of our most intelligent engineers of the Eastern States, and still believe him to be, but I must say he has decidedly made a break on this matter, feeling perfectly satisfied that he knows better, but, because he has valves that are in such poor condition that they require the wrench put on the wheel to keep them from leaking, is no excuse for him coming out and claiming because he uses a wrench that it is right for others to do so.

It has a tendency to encourage those who are somewhat inclined to make use of this habit to still continue the practice, and those who condemn the use of the wrench to be questioned, when they forbid it.

Mr Wakeman lays great stress on the flushing up in the face by using the hands in closing the valves. If a person closes a valve that is in good condition, he doesn't have to flush up. The writer has seen men take a new valve and turn down on it until they did. Now was there any cause for doing so when they had no indications of any leak on this valve? I would like to ask if a man knows anything about valves would tolerate any such practice as this? If so, I do not for one, and if Mr. Wakeman wants to use his wrench on valves, he is at liberty to do so. I think it is altogether wrong to advocate the same, as he has done.

He also says he has one 3½ inch valve he can close with his finger or open in like manner. I am pleased to hear him say he has one valve on his plant that is in good order.

The writer has five valves that I can do the same with, and I have done it hundreds of times. Two of them are four-inch, two five-inch and one six-inch, and they are steam tight.

Mr. Wakeman asks me what I would do with his valves. I would make them right, if they are in condition to be made so, especially the one that he mentions as leaking steam during the night, or else I would remove it.

Abington, Mass. A. T.

Economy in Firing Boilers. Damper Regulator.

EDITOR THE PRACTICAL ENGINEER:

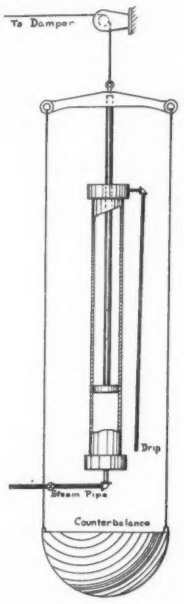
With the sharp competition which prevails at the present time, the success of a manufacturing enterprise depends to no small extent upon the cost of power and its production, and therefore this becomes a very important item and cannot be too closely considered. Boilers should never be manipulated by either the ashpit doors or the furnace door but in all cases by the damper. When it becomes necessary to check the heat generation, a good damper regulator is indispensable. If the ashpit doors are closed, the heat is allowed to be carried off through a partial vacuum which is created by the draught of the chimney, by not getting the proper amount of air, and hence the heat is taken from the furnace to the atmosphere without doing work.

In partly opening the furnace doors, when the man in charge observes the steam getting high, the boiler will become cool, besides allowing the heat to escape faster than the coal can radiate it. The result is extra expense of replacing the brickwork and repairing the boiler, and if continued long will make the boiler unsafe to run.

I happened to be in a small plant one day and I asked the engineer why he handled his boilers as above. The only explanation I received was: "I shovelled coal before you were born." Some engineers will tell you how long they passed coal at sea and how much coal they could shovel, but where intelligence and ambition do not predominate, such engineers are better qualified to pass coal.

In reference to the damper regulator, I once got a job in a factory where there was none and I found that I could not induce the firm to get one. They claimed that the engineer's department was already under too much expense, so I made one myself as follows: I took a piece of 2″ brass pipe 18 inches long and screwed a cap on both ends. To the bottom

cap, I connected a ½" steam connection. I used a piston made from a valve disc with an iron rod attached running through the upper cap. The upper end of the piston rod was screwed into a cross piece 8" long, on each end of which was attached small iron rods connected to a small iron receptacle which contained scrap iron to the amount of my damper regulation.



An Improvised Damper Regulator.

I also ran a ¼-inch brass pipe from the upper part of the chamber to carry away any water that might accumulate above the piston. This arrangement worked entirely satisfactory and when the firm saw the benefits derived, I had no difficulty in getting almost anything I asked for except more salary and when I left this place, taking with me my improvised regulator, I learned they had a new one put in from some manufacturer.

Brooklyn, N.Y. J. G. S.

Explosions in Cylinders of Air Compressors. Graphite as a Lubricant in Air Cylinders.

EDITOR THE PRACTICAL ENGINEER:

An explosion recently occurred in the air cylinder of an air compressor at a mine in Utah, the cause of which was oil in the air cylinder. The accident was severe, resulting in the death of the assistant engineer and the serious wounding of the chief engineer. The explosion was terrific. The back cylinder head was shattered, while the back flange of the cylinder was torn off at several points. At the time of the explosion, the chief engineer was kneeling in front of the cylinder manipulating the inlet valve, while his assistant was standing close by. The assistant was hurled under a work bench about ten feet distant, badly mangled, while the chief engineer struck the wall in an unconscious condition. These two men were alone in the engine room at the time, and when the chief regained consciousness he realized that the compressor was running away, and he struggled to the throttle, falling twice in attempting to shut off the steam, which he finally did, thus preventing the destruction of the compressor, as the governor was rendered useless by the explosion. Part of the cylinder head tore out a window and shot fifty feet beyond the building. At the time of the accident they were compressing air to eighty pounds pressure at sixty revolutions.

Such explosions are fortunately rare in compressor service and they serve to emphasize the importance of using only the best grade of air cylinder oil. Cheap oil has no place in air cylinders or air passages, and even with the best oil, explosions may occur if too much oil is fed into the cylinder, and if sufficient care is not taken to keep the valves and parts clean and free from deposits. A form of kerosene engine is made to act on the principle which is illustrated by explosions in the cylinders of air compressors. This oil engine has a chamber which is at first warmed by the heat of a lamp applied externally. After there is sufficient heat to cause the explosion of the kerosene, the lamp is removed and the temperature of the chamber is sufficient to continue these explosions at each return stroke of the piston, which forces hot compressed air in contact with this oil vapor. Here is an engine acting on the explosive principle similar to that in use in all oil engines, yet there is no spark or other direct means of ignition. In the cylinder of an air compressor, as the piston approaches the head, it compresses the air to a point which both in pressure and temperature is sufficient to cause an explosion, provided there is oil vapor present, the flashing point of which is about the same as the temperature of the air in the cylinder. In the case of the oil engine referred to, the heat of the cast-iron affects the explosion, and in an air cylinder we have a similar condition in the shape of a hot cast-iron cylinder and heads. The temperature of air compressed to 70 lbs. gauge, from 60 degrees Fahrenheit, has its temperature raised to 404 degrees. The air lift system of raising water, of which the writer has charge, requires a temporary pressure of 125 pounds of air to start the water in tank. Air at this pressure has a temperature of about 540 degrees Fahrenheit, nearly the melting point of lead. Joints about the air end of a compressor should not be made with rubber, but copper gaskets or faced joints only should be used. To avoid any danger from explosions from the use of oil with a low flashing point, the writer has adopted pure flake graphite as a lubricant for air cylinders. After five years' use of graphite in the air cylinder of the compressor of which he has charge, a late examination shows the interior to have a polish like a mirror, the rings the same, and a slight scratch on bottom of cylinder, existing when graphite was first used, has completely disappeared. Graphite, as a lubricant for air cylinders, is, in the opinion of the writer, the ideal one as to effectiveness, price, and safety. The highest heat does not affect its value as a lubricant.

Sanger, Texas. A. H. G.

Minimum Amount of Cylinder Oil and Waste to be Used in a Steam Plant per 100 H. P. per 24 Hours.

EDITOR THE PRACTICAL ENGINEER:

This subject, I believe, will interest the readers of "The Practical Engineer" and can be solved better by the men at the throttle than the members of any highly educated and theoretical society. The above question was asked the Institute of Mechanical Engineers by the educational committee of the N.

A. S. E., but up to date I have seen no reply. An article in the January issue of "The Practical Engineer" by O. C. S., Phila., Pa., covers the testing, viscosity, etc., of oil in a most practical manner worthy of being remembered by engineers in general.

In experimenting on this subject, I have found that I could run a 22 x 48 Corliss engine turning 90 revolutions per minute, 400 rated H. P. on 8 pints of oil using a ratchet lubricator and still have a margin for safety. Reduced to a basis of 100 H. P. per 24 hours, this would give 2 pints per 100 H. P. per 24 hours. To find the margin of safety, I reduced the amount of oil to 6 pints, equally 1½ pints per 100 H. P. per 24 hours when I could notice after running an hour, a slight chatter in the valves, showing the engine close to the danger point of cutting.

Now an engine with a positive valve gear would not have shown the danger point so quickly and for that reason, considerable damage could be done in that class of engines unless considerable care be taken. It is a well-known fact that nine-tenths of the stationary steam engines use considerable more oil than is necessary. All over the amount necessary to lubricate the moving parts is a dead waste, as no invention thoroughly separates all the oil from the steam. I do not believe it a good plan to try the experiment of some marine engineers of using kerosene oil continuously and when the engine grunts badly to inject a small amount of cylinder oil until the grunt stops. This is done on account of their fresh water being scarce, as they use the condensed steam over and over to feed the boilers. It is surprising how well the engine cylinder walls and valve keep on this diet of kerosene. It is claimed for this that it is easier to repair cut cylinder and valves than it is to repair burnt out or busted boilers and there is some truth in this.

In the consumption of waste per 100 H. P. per 24 hours, we have entirely eliminated that so-called luxury and filled its place with an abundance of a better and cheaper article. It stands to reason that no plant can be kept clean when the engineer is restricted to a certain amount of waste per 100 H. P. per 24 hours, as it gives the engineer or oiler a valid excuse for his plant being dirty. We tried a number of substitutes for waste, such as flannel cloth from underwear factories, there being a number of these in this vicinity, with little success. We then tried honeycombed toweling, that can be bought at any dry goods store for $1.00 a roll and found it very satisfactory. It will make 30 towels 20" x 14" or 18" x 12" according to the width of the goods. Have the edges stitched so they will not fray or tear and so that it will leave no lint, which is a source of trouble when filtering oil. These towels make a cleaner job, and with reasonable wear they will last a year without renewal. We were using between one bale and one and one-half bales of waste a month, costing $10.00 a bale.

We take a kerosene barrel and place it in a convenient place near the hot water in the boiler room to be used as a receptacle for the oily towels. When the towels are nearly all dirty, with a small wringer costing about $1.00, wring all the oil out of the towels and cover them with a hot solution of some cheap washing powder. Let them soak for 8 to 10 hours pounding them once in a while. At the end of this time empty dirty water and renew solution. Let stand the same length of time, pounding them as before after which when they are wrung out, they will be as clean as new.

It is needless to say that the man, whether he be engineer or oiler, will be economical to a large extent in their use when he knows he will have to wash these towels. As the towels get worn they can be used in a mop, generally two; one to wipe the heavy oil from bed plate and pans, the other for under shafting. Buy a squeezer or mop wringer costing 50 cents or $1.00, place in a pail or other receptable, wring the oil from mops, let settle a day or two or until pail becomes nearly full, then empty in filter. 50 or 100 of these towels should be made up, as it will be longer between wash days. Two or at the most three towels will be sufficient to thoroughly clean the largest size engine. They will not sop up or hold as much oil as a bunch of waste but that is not necessary as the mops will take care of all heavy quantities of oil. We find from practical experience that they are a great saving and better to clean a steam plant with than waste.

Troy, N. Y. A. M. C. K.

Rodney's Troubles.
Or Do We Need a License Law in Michigan?

(Tenth Letter.)

Mr editur, deer sur, i hev had kwite a bit ov trubbel lately with mi steem gaig whut shos the preshur on the biler. the uther day when i had brung mi masheen hum frum histen the timbur at warfuls bridge, i lukd at the gaig and thear wuz steem sizzen out aul around the gaig. well i thot sumthen wus rong, so i tuk it down off ov the biler, i wuz taken it apart when henry cum along and wanted tu no whut wuz the mattur. i told him to wate and see. well i tuk the hand off with a pare ov pinchers, then i tuk off the littel skruze what holds the plait with the figgers on, then we kud see the wurkses. it wus sumthin lik a klok. inside thear iz a small pipe lik bisnus thet gose around the inside ov the gaige box. well we kuddent see whear it wuz broke so henry sed to put it on the biler and git sum preshur on to it so ef it leekd wed see it. I kind o listend tu henry fur he haz a job watchen nites at a bisickel facktiry ovur at loonsdail, and henry sez he haz a gud deel to du with winding kloks and he sez he sees a lot o differnt kinds ov masheenery, so i pade sum attenshun tu his tok.

well we got steem on the biler and aftur a while I turnd the steem intu the gaig and it blode out ov a littel hoal in that littel pipe whut goes around in the gaig box. henry askd me how mutch steem i karryed on the biler and i told him 60 pounds, and he sez tak the gaig down and ile fix it fur u. well i tuk it down and henry went into the house and got sumthing frum his bisickel bisnus, he tuk the littel pipe out ov the gaig and rapd sum of the stuf he had in his hand around the pipe whur the hoal shode. i askd him whut it wus and he sed bisickel tape, sumthen fur to fix the tires with, he sed that the tires when pumpd up with air had a preshur ov ovur 80 pounds on em, and it ot tu hold the gaig whur thear wus onli 60. well we put the hull thing tugether and i maid shure tu sett the gaig hand at the nothin mark when i druv it on, we put the gaig on the pipe on the biler and do u beleeve me the thing begin tu leek rite away. i was very mad at henry about this trubbel, so he tuk me down tu the bisickel facktiry and up in tu whut he sed wus the semblin rume and shode me wher the feller wus testin sum job he had jist dun, and it wus a tire rapd with that stuff and mr editur it stood moren 85 pounds.

now pleeze tell me whi it dont stand on mi gaig, and tell me how i kan git thu gaig fixd. pleeze rite rite away fur ime a littel skiddish with out enny gaig.

rodney gumkirk
orkners corners care of mi father
munrow kounty.
Mishegan

The Engineers We've Had.

No. 3.—The Know-it-all Engineer.

There wasn't a thing invented, and there wasn't a new machine,
But what our Jim knew all about ere they were even seen.
There wasn't a plan proposed by man, that he couldn't knock out flat,
And there wasn't a rule you mentioned, but he had it all down pat!
But he never seemed to know these things 'till some one told him how
The things were done or figured. Then you ought to see him bow
His head in swift approval of the plans—then he would roar:
"That's right enough, my hearty, but I knew it all before."

One day, the boss brought in a friend, who looked at Jim so queer,
He drew himself up 'dignified,' and said: "I'm engineer,
And now, sir, if there's anything you'd really like to know
About this plant, I am the only one these things can show."
The boss walked off a smilin', and the stranger bowed with grace,
And said to Jim, "I'll be real glad to look around the place.
But show me where you get the steam to make your engines go."
"Come on, my friend," said Jim, "for there is nothing I don't know."

They came into the boiler room—"them's bilers, sir," said Jim,
At that we winked and smiled, then started in our coal to trim.
"Them's bilers, and that's where we get the pressure of the steam.
The fire boils up the water, when the pump sends in a stream."
"They must be strong?" the stranger said, "you bet they are," said Jim,
"How strong are they?" "Well now, I knew, but memory does get dim."
"How do you tell?" "Well, come around here in a day or so.
I'll look it up again," said Jim, "and then I'll let you know."

"How many braces have they? What strain is on each brace?"
—And then we noticed that poor Jim grew paler in the face.
"What is their tensile strength? How long? How many flues have they?"
—And Jim stood with an open mouth, and not a word did say.
"What is the surface of the grates? How high's your bridge-walls then?
How often do you clean them?"—Here Jim woke up again.
"Oh! when the mud shows in the water in that little glass."
The stranger said, "My man, I am afraid that you'll not pass."

"Say, who are you?" Jim hollered, "that you dare to question me?"
"I'm just the new inspector. Now, your license let me see."
Jim brought it, and the stranger, taking it from out its frame,
Just fired it in the furnace, where it soon went up in flame.
Poor Jim! Next day a letter from the boss for him arrived,
Which said: "We're sorry, James, but from the answers he derived
From you about our boilers, the inspector wishes much
That we discharge you, which we do—because you know too much."

Crude Oil as Fuel.

Editor the Practical Engineer:

I have read several articles written about crude oil as fuel, but have not seen anything that compared with the use that we put it to in Southern California. There is hardly one place that requires heat that we do not use crude oil. In generation of steam, both stationary and locomotive, small traction engines, blast furnaces, lime-kilns, brick-kilns, baking-ovens, and even in cooking-stoves, it is used for fuel.

The principal reason for using it is the scarcity of other fuel. Coal is scarce and of poor quality, yet the price is high, varying between $11.00 and $12.00 a ton. Wood is scarce and is very high in price, a California cord being only one-half of an Eastern cord. Oil is abundant thus far and reasonable in price, it costing 90 or 95 cents a barrel.

In locomotive and traction work, it is fed to burners by gravity. Some stationary plants also have gravity feed, but most large plants have oil pumps and carry from 30 to 40 pounds pressure. Large storage tanks are usually built underground, where large quantities of oil are stored, just as large bunkers are built for coal. There is very little machinery required to handle the oil, usually one large duplex steam pump is all that is necessary to pump from the storage to the supply tank, and generally two small pressure pumps to deliver the oil to the burners.

In order to maintain a uniform pressure on the oil lines to the burners, a tank of some sort is placed between the pump and the burners. This forms a cushion and the pressure is kept constant by a bypass valve; either a spring valve or hand regulated. I find by placing this valve beyond the burners, better results are obtained than when otherwise placed. We use two types of burners: the spraying and the atomizing type. In the first, the oil and steam (or air) issue from separate openings in the burner-tip. In the latter the oil and steam (or air) mix before issuing from, and through the same opening in tip. Firing with oil is very nice in every respect. There are no dust, no ashes, no coal shovel to wield, no clinkers to break, no fires to clean or bank, yet there is some soot to contend with, heavy fires are hard on eyes and there is always a deafening roar and some danger in gas explosions which are very serious at times.

In conclusion, I want to state that this letter is not intended to encourage engineers in the East to leave their jobs, thinking that it would be a snap to come here and get a job. If you do, you will be sadly disappointed when you arrive.

Los Angeles, Cal. A. H.

Locomotive Boilers.

EDITOR THE PRACTICAL ENGINEER:

In the March number of your valuable magazine, among the questions and answers I note the answer to the question in regard to the safety of firing a locomotive boiler, as shown in sketch. Your reply is that it will work satisfactorily. Now while the boiler in mention may be in service and giving good results, I think that the method is not always a safe nor practical one for the several following reasons. The mud leg of the boiler under the throat sheet being exposed to the hottest part of the fire from the furnace will leak after a short time, provided the boiler is a locomotive boiler; that is, one originally constructed for the railroad engine. At the bottom of the mud legs of these boilers there is a large frame fitted which separates the inside sheet from the outside sheet, thus forming the water space, and commonly termed mud leg. This frame or mud ring, as it is commonly termed, also serves as a rest for the firebox portion of the boiler on the frame of the locomotive. The grate bars of the locomotive are placed inside of and above this ring, so that the rivets or seams of these joints are none of them exposed to the fire. In the cut on page 23, it shows where this mud ring would be exposed to the hottest of the fire, which will probably cause the sheet to burn. The rivets will get red hot and expand, causing the joint to leak. Fire cracks will also show, after the boiler has been run a short time, because the rivets are too far from the water space and are exposed to more heat than originally calculated for.

Great care should be taken in an arrangement of this kind in regard to the blow-off connections. There would have to be at least three valves on this boiler, one at the foot of each mud leg on each end of the original firebox and one in the shell over the furnace, for in a boiler of this type the scale and sediment accumulate in the mud legs and at the bottom of the shell, especially when fired as the cut shows. Some time ago the writer had charge of the repairs to several boilers of the locomotive type. The repairs consisted of new fireboxes in some and mud ring patches in the others. The boilers were used to furnish steam for large hammers in a forge works. The heat for the boilers was from the heating furnaces, the boilers being set on suitable masonry, so that the firebox of the boiler was directly over the flue of the furnace. On careful examination of each firebox, I found that the inside or firebox sheets were fire cracked at the bottom where they were riveted to the mud ring, the seams and rivet heads having been exposed to too much heat. There is much scale and sediment in the water in the section where the boilers are and the boilers have to be cleaned thoroughly every two weeks. Each boiler has a blow-off cock on each corner of the firebox, and a scum cock just over the crown sheet in the back head.

These boilers had the very best care but it was proven to me that the seams should not be exposed to the intense heat, so when I had the boilers replaced on their settings, I had the main flue made one course of fire brick smaller, so as to allow for two courses to extend up inside of the firebox. The first course inside the firebox was placed on its edge and the next course on top on the flat, the brick on edge being placed so as to allow for an air cell between the brick and the boiler, thus preventing the intense heat from coming into direct contact with the seams at the joints. By forming this air cell the brick work was prevented from cracking, owing to the expansion of the boiler. This method has been in service double turn night and day for four months and there have been no repairs as yet. So in conclusion I think I can safely say that it is not the best policy to expose the mud legs of a locomotive boiler to the flames from the furnace fire.

N. W. Ark.

QUESTIONS and ANSWERS

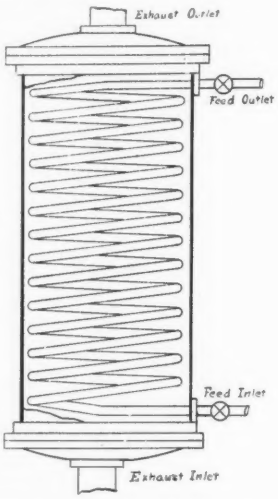
THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

Expansion of Water.

EDITOR THE PRACTICAL ENGINEER:

As a subscriber to your valuable paper, I have an interesting question to ask:

Suppose a heater coil is entirely filled with water at a temperature of 60 degrees and both the inlet and outlet valves are closed. When the engine is allowed to exhaust through



the heater, what pressure will the water in the coil have attained when the temperature has been raised from 60 degrees to 212 degrees, the temperature of the exhaust steam?

New Bedford, Mass. A. B. C.

[We would be very much pleased to hear from our readers in reference to the above question.—Ed.]

EDITOR THE PRACTICAL ENGINEER:

What opinion and information can you advance relative to the question of economy between steam and gas engines in a plant which must be heated in winter? Is it possible to run a

gas engine and use separate means of heating a building for factory purposes as cheaply as can be done by the steam engine from which the exhaust can be utilized?

In the absence of relative data, it seems to me that the gain from the use of the exhaust would more than cover any slight gain in the cost of power alone, leaving out any consideration regarding the generally accepted reliability of the steam engine as compared with the gas engine. Again, would it be as cheap or cheaper for a manufacturer using 250 H. P. steam plant to dispense with same and install gas machines and heating arrangements and make his own gas?

Phila., Pa. E. E. T.

In reference to this question about whether it would be more economical to run a gas engine and do the heating separately, or to run a steam engine plant, it is such a broad subject that it cannot be answered directly, as what might be said of one plant will not apply to another.

A gas engine considered as a machine for transforming the energy in coal into useful work is superior in point of economy to the steam engine, and having no boiler or feed pumps, the amount of machinery required is less, and consequently the cost of attendance. On the other hand, where a heating system is operated in connection with a power plant, the advantages possessed by a gas engine disappear. The cost of operating a gas engine is often much more than appears at first sight, as it is more liable to get out of order and consequently more difficult to handle; and, while it is true that a fireman's services are dispensed with, it often requires an expert to make necessary repairs. The method of starting up gas engines has always been a more or less troublesome one. After the gas is turned on it becomes necessary to turn the engine over several times before the engine begins to run by itself. This is done in small engines by hand, but in larger ones it requires some auxiliary device, such as a compressed air apparatus, which in small machines, makes the price expensive, and which in larger machines is necessary.

When the gas engine is used in connection with a lighting plant, a storage battery may be used with the double purpose of keeping the voltage on the outside circuit constant, as the gas engine does not in general regulate as closely as a steam engine, and of starting up the gas engine. In general it may be said that gas engines can be used to advantage where power is required for irregular intervals, as it is always ready to start, but it is probable that where all the exhaust steam is utilized for heating, the steam engine will be the cheapest to use, although it is claimed that the water which runs through the jacket of a gas engine can be used for heating.

As regards the first cost of engines for equal power, the gas engine is more expensive, and in the case where a producer power plant is installed, the cost of this will equal the cost of the boiler part of a steam plant, and whether it will be more or less expensive will depend somewhat on the gas storage provided.

The cost of steam plants varies greatly with the locality, size, kind of machinery, boilers and many other items. The cost of a steam plant, including everything, except the buildings in which it stands, varies from $50 to $55 per horse power for high speed engines and from $65 to $75 for slow speed Corliss engine plants.

The cost of generating steam power is extremely variable and depends upon many factors, among which may be mentioned the kind and steadiness of the load, the hours of service per day, the kind of engines, quality of fuel, and the efficiency of boilers and engines. The average of a great number of tests shows that it costs about ¾-cent per hour to generate one horse power.

The cost of gas power varies and depends upon the kind of gas used, the size of engine, the character of the load and the cost of material used for fuel. A number of tests show that the cost of gas power varies from ½-cent to 2 cents per horse power per hour and the complete cost of the gas plant will be about $65 to $70 per horse power, which is about the same as for steam power.

It is therefore only after a careful study of existing conditions that it can be said which is the best engine adapted to each individual case.—[Ed.]

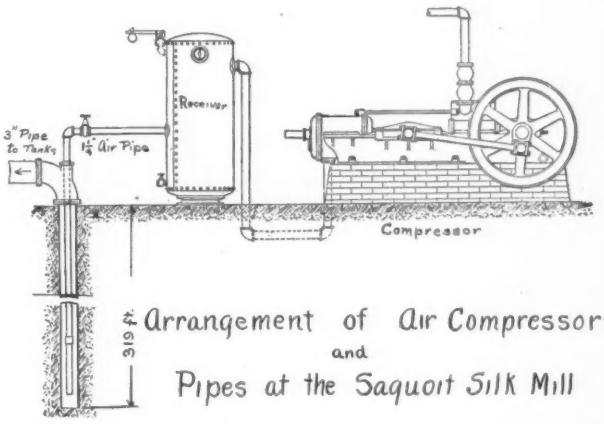
EDITOR THE PRACTICAL ENGINEER:

In the May issue of your paper, there is a description of the Sauquoit Silk Mill Plant. Among other things it says: "There is an Ingersoll-Sargeant air compressor for raising water from a driven well 319 feet deep."

In what way is the air used to raise the water? You will greatly oblige me by giving any information on this subject.

San Francisco, Cal. J. B.

The arrangement of the pipes of the air compressor, receiver tank and well, spoken of in our description of the Sauquoit



Arrangement of Air Compressor and Pipes at the Saquoit Silk Mill

Silk Mills, is shown in the accompanying sketch. The air compressor forces the air down the inside pipe, which is 1¼" in diameter. The outside pipe, which is 3" in diameter, has its end submerged in the well. The compressed air forces a rising column of air mingled with water in the outer pipe to the supply tanks, which are situated at the top of the building.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

Will you kindly explain to me why the indicator diagram represents the work done by the engine and why is it that some engineers use the number of strokes in the horse power formula and others use the number of revolutions? This is very confusing to me.

St. Louis, Mo. G. W. B.

The answer to this question will be found in another column of this issue and was written to answer this question.—[Ed.]

Calculations Simplified.

By Prof. A. Edward Rhodes.

PART I.

For the average engineering problem, it is not necessary to use the higher arithmetical and algebraic formula, although in many cases it is more simple and more learned looking to write the rules and formula in a way that is decipherable only by a few specialists. Most engineers understand decimals, therefore in the problems given, if it is desired to find if any bolt or bearing that you may have is correctly proportioned, you need only do a little addition, subtraction, multiplication, or division. Illustration: Suppose you have a bolt 1.2 diameter at root of thread and want to know how many pounds pull it can safely stand. You look at Fig. 1 and read: A bolt can stand about 4500 pounds pull per square inch with perfect safety. The diameter of your bolt is 1.2″, its area would be $1.2 \times 1.2 \times .7854 = 1.13$ nearly. Now, if one square inch will stand a stress of 4500 pounds, 1.13 square inches will stand $4500 \times 1.13 = 5085$ pounds.

In any case where no formula is given for a certain part, it is understood that the thickness of metal for that part is

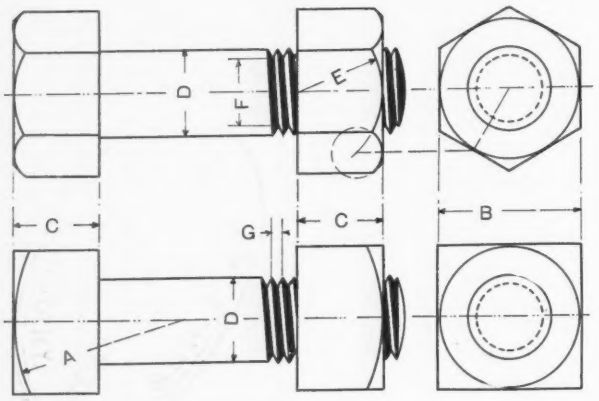


Fig. 1.

not important, or that it is controlled by other conditions that will determine the measurement.

Formula. Figure 1. Bolts.

A = 2D.

B = 1.5D + 1-16″.

C = D.

D = diameter of bolt = unit of measure.

E = D.

$F = D - \frac{G}{1.3}$ nearly.

G = pitch = number of threads per inch.

Safe stress on bolt = 4500 pounds per square inch.

Allowable load on bolt in pounds = area of bolt × 4500.

Area in square inches at root of thread = $F^2 \times .7854$.

Figure 2. Pedestal for shafts up to 4″ diameter.

A = 4.5D.

B = D or more.

C = .09D.

D = diameter of shaft = unit of measure.

E = .25D + .2″.

F = 1.75D.

G = .25D + .13″.

H = .3125D.

I = .3D for two bolts, or .18D for four bolts.

J = .2D.

K = 2 to 4D.

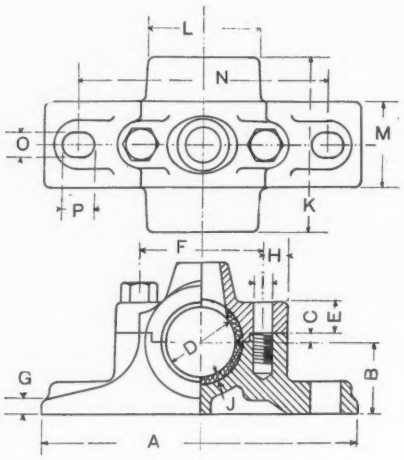


Fig. 2.

L = .75D + D.

M = 1.5D.

N = 3.5D.

O = .3D + .125″ for two bolts, or .18D + .1″ for four bolts.

P = O + ¼″.

Figure 3. Ring oiling bearing.

A = 4.5D + 1″.

B = 1.5D + .25″.

C = 3D + 1.25″.

D = diameter of shaft = unit of measure.

E = 3.5D + .625″.

F = 1.8D.

G = 1.75D.

H = .3D.

I = .3D + .125″.

J = .3D.

K = 2.5B.

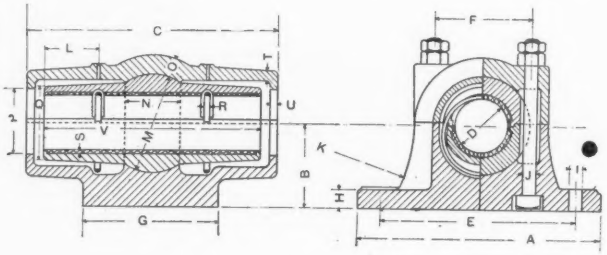


Fig. 3.

L = .25V.

M = 1.75D.

N = D.

O = .35D.

P = D + .25″.

Q = 1.4D.

R = .25″ constant.

S = .2D.

T = .32D.
U = .28D.
V = 3D.
Figure 4. Pedestal for shafts 3″ to 8″ diameter.

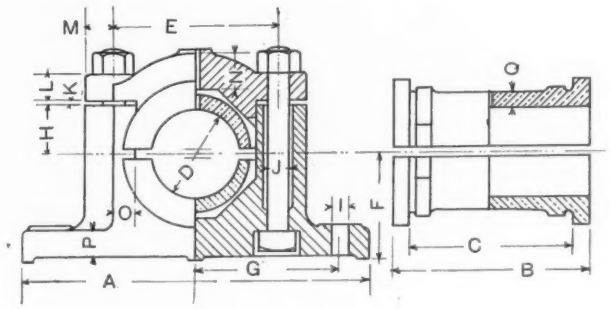


Fig. 4.

A = 4.25D.
B = 2D.
C = 1.625D.
D = diameter of shaft = unit of measure.
E = 1.75D.
F = 1.2D.
G = 1.75D.
H = .44D.
I = .3D.
J = .25D.
K = .07D.
L = .38D.
M = .44D.
N = .44D.
O = .25D.
P = .4D.
Q = .1D + .25″.

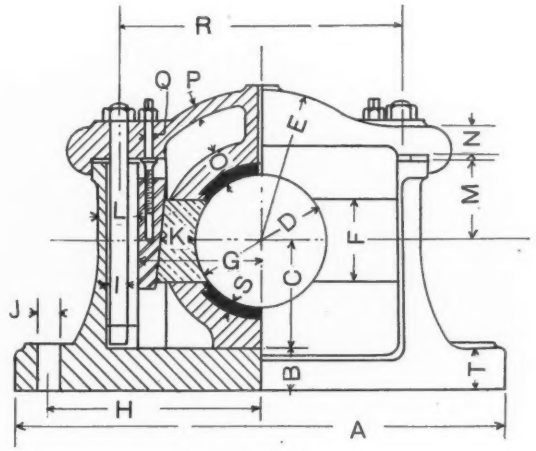


Fig. 5.

Figure 5. Pedestal for shafts 8″ to 18″ diameter.
A = 3.5D + 1″.
B = .25D + .625″.
C = .7D.
D = diameter of shaft = unit of measure.
E = D + 1.125″.
F = .5D + 1″.
G = .825D — .25″.
H = 1.5D.
I = .18D for four bolts.
J = .18D + .25″.
K = .12D.
L = .25D + .5″.
M = .5D + 1.25″.
N = .25D + .5″.
O = .1D + .6″.
P = .1D + .325″.
Q = .1D.
R = 1.8D.
S = .5″ for 12″ or less, and .625″ for over 12″ shafts.
T = .25D + .625″.
Figure 6. Foundation plate.
A = 3.5D.
B = D.

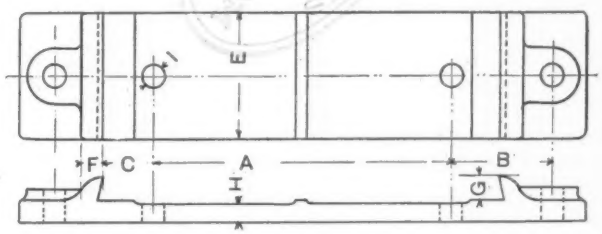


Fig. 6.

C = .5D.
D = diameter of shaft = unit of measure.
E = 1.5D.
F = .25D.
G = .3125D.
H = .25D.
I = diameter of hole in pedestal.

Our Semi-Annual Letter from "The State of Manayunk."

Mr. Editor,

Dear Sir: Manayunk Council is still alive and all well but me. We had election and installation. These are the statesmen, diplomats and dancing masters who will administer our affairs for the next six months. If any of them fail to size up to the high standard set by their predecessors, I will write you about them. The bunch: Chief Engineer, Geo. Arnold; Assistant, John Carson; Recording Engineer, F. J. Armbruster (you know "Flory"); Corresponding Engineer, John Clevenger (State of Manayunk); Financial Engineer, Geo. Carpenter (he's an engineer as well as a carpenter); Treasurer, Wm. Beatty (better known as our "Billy"); Senior Master Mechanic, Ed. J. Delaney; Junior Master Mechanic, Valentine Dutton (guess he was born on the 14th of February); Inside Sentinal, Geo. Richardson; Outside, John Hill; Chaplain, Norces Warner; Trustee, Andrew Roberts, Sr.

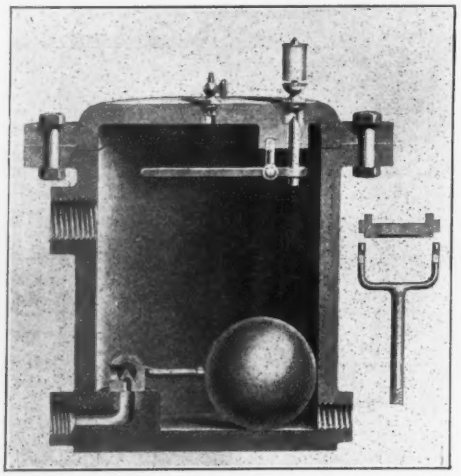
I think them a good team. Times are not very brisk with us but with Richardson as captain, Armbruster at the wheel, and Beatty carrying the chain, I think we will have a successful excursion to Augustine Pier in October.

JOHN CLEVENGER.

A Corliss Valve Steam Trap.

It has been generally recognized by engineers and mechanics that the Corliss liberating valve is among the best type of valves used in steam engines to-day. For this reason, John T. Lindstrom, of Allentown, Pa., has incorporated this principle in the latest trap designed and manufactured by him.

The Lindstrom-Corliss valve steam trap is constructed to avoid lifting the valve off its seat, thereby preventing any grit and scale from getting between them. The construction and mechanism, as can be seen from the accompanying illustration, is very simple. It consists of a cast-iron box, the Corliss valve and float and the safety alarm device. At one side of the cast-iron case, near the bottom, is a cored outlet. Into this outlet is screwed a bronze valve chamber, having inlet and outlet ports. This valve chamber is bored and ground to fit the liberating valve, shown in the sectional view. This is a balanced valve having small wearing parts with consequently little friction.



Lindstrom Corliss Valve Steam Trap.

The ends of the valve on each side project beyond the valve seat and are square in section. These square ends are engaged to the fork arm connecting the copper float. No screws or pins are used in this connection. As the centre of the valve is the fulcrum of the float, the float has great lifting power, so that only a small float is required, the advantage of the small float being that it is better able to withstand a given pressure.

When the trap is in operation, the water of condensation enters the trap through the inlet near the top. As the water in the trap rises, the copper float will rise also and move the valve, which has a small lap. When the valve has been moved sufficiently to uncover one-fourth of the port opening, the opening is of sufficient size to take care of all the water in the trap, leaving three-fourths of the opening available in cases of emergency.

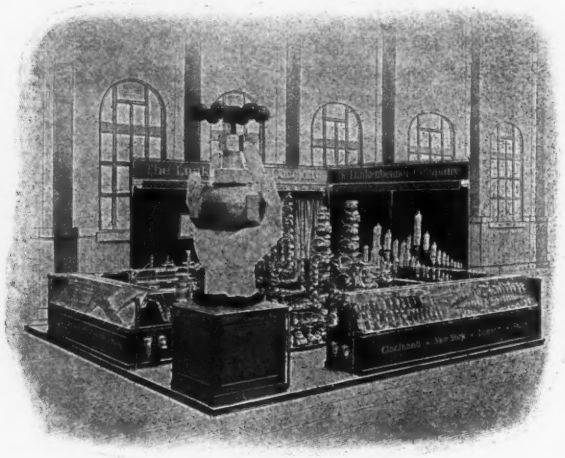
Connected to the trap is an automatic alarm which gives warning in case the outlet to the trap is closed. This sometimes happens when boilers use dirty water. When the mud gets separated from the water in the boiler, it will float on the surface and be drawn up with the steam into the steam pipe and together with the condensation, it will float into the trap. When in the trap, this mud will accumulate and fill up the outlet, if not blown off frequently. The level of the water in the trap will then rise, giving the alarm.

It will also sometimes happen that the water will rise a few inches above the regular level during a sudden income of water, and will give an alarm, but at such times the alarm will stop blowing as soon as the water is discharged. If the alarm keeps on blowing, it indicates that something is wrong, and the attendant can in a few minutes remove the cover and clean the trap, and as the cover is ground, no packing is required.

The Lunkenheimer Exhibit at St. Louis.

In Machinery Hall Building, location 5G, black 26, is the unique exhibit of the Lunkenheimer Company. It is easily identified by a large model of their familiar Valve in Hand, which occupies a prominent corner of their exhibit, as shown by cut.

Pyramids of globe, angle, cross, lever and gate valves, of various designs and sizes, both brass and iron, are artistically



Lunkenheimer Exhibit at St. Louis.

arranged about the exhibit, and are agreeably off-set by a black plush curtain at the side and rear.

The glass cases arranged in front of the exhibit contain a smaller class of the goods manufactured by them, such as lubricators, oil and grease cups, cocks, etc., of all sizes. Neat designs of racks containing various sizes of whistles, injectors, pop valves and a variety of other specialties, tend to make up an exhibit worthy of notice. A new design of water gauge and oil-pump for cylinder lubrication are features in themselves.

Dispersed about the exhibit are pipe fittings of every description, together with whistles, safety and check valves and numerous other appliances.

The large variety of steam goods exhibited by the Lunkenheimer Co. and manufactured by them, necessitates more than a casual glance to thoroughly appreciate the exhibit in all its details.

Sterling Dust Collectors.

The accompanying illustration is a reproduction of a photograph of a Sterling Dust Collector which is in operation at the New York Central and Hudson River R. R. Co.'s shops at East Buffalo, N. Y. At these shops, the shavings are loaded automatically into the cars as fast as they are made by the wood-working machinery, in the cabinet and other shops,

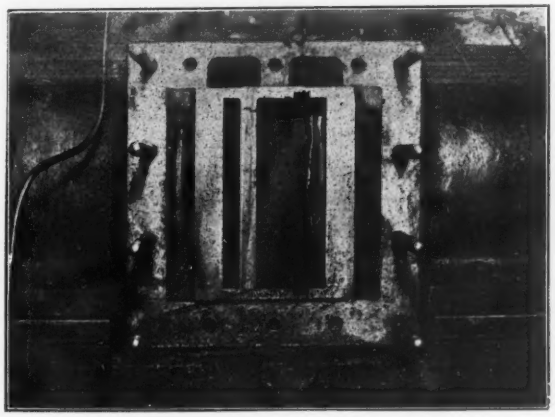
thereby doing away with any manual labor in handling this waste product. The dust collectors allow the fan to operate at its full capacity without causing any back pressure. They are in use in six United States Navy Yard plants as well as many

Sterling Dust Collector at East Buffalo.

other car building and ship building plants. Any further information can be obtained by addressing the Sterling Pipe and Blower Co., Hartford, Conn., who are the manufacturers.

Engine Bridge Wall Repair.

The accompanying illustration shows the cylinder of a 20-inch Hobb-Fontain engine that met with a mishap. A large quantity of water passed from the boiler into the cylinder, breaking out one of the bridges between the live steam and exhaust port. Upon examination it was found to be a case of repair or of a new cylinder and as time was the important consideration it was decided to repair it. Consequently a new



Valve Chest showing broken Bridge Wall about to be repaired.

bridge was made and put in so as to make the repair a permanent one.

The break extended nearly the whole length of 14 inches, so it was thought best to cut it all out and cut a recess along the bottom and at each end. A new partition was snugly fitted with its proper curve into the grooves, finishing the two ends and bottom with a series of grooves, which fitted into the grooves cut into the cylinder. A strip of ucedarium was cut and laid in the bottom of the grooves in the cylinder.

The ends of the new bridge were made shorter on the bottom than on the top. The bridge was forced in as far as possible when cold, then steam was admitted to heat the cylinder, when a heavy pressure was applied, forcing the new bridge in further. After three successive heatings it was down solid, having pressed all the packing out except what was contained in the grooves mentioned. Then two tap bolts were forced home and the whole arrangement made steam tight and permanent.

H. B. Underwood & Co. performed this piece of work and only delayed the mill, in which the engine was installed, a short time and they feel confident it will be as permanent as ever. This is only one of the many interesting jobs they are called upon to do, which are made possible with their equipment of portable tools.

Philadelphia Council.

On Wednesday evening, July 13th, Deputy Supreme Chief Engineer Frank J. Cannon, assisted by Supreme Senior Master Mechanic Jas. K. Holland, installed the following newly-elected officers of Philadelphia Council, No. 7, A. O. S. E.: Chief Engineer, Sheppard Adams; First Assistant, Michael Helmstreet; Recording and Corresponding Engineer, W. S. Wetzler, 753 North 44th St.; Financial Engineer, Wm. Pairent; Treasurer, Wm. J. Eccles; Chaplain, Wm. Rothwell; Senior Master Mechanic, Chas. M. Comer; Junior Master Mechanic, W. H. McCaughn; Inside Sentinel, Ed. Whalen; Outside, John Golden; Trustee, Joseph High.

Philadelphia Council is progressing finely. Its location at the N. W. Cor. Broad and Filbert makes it convenient for its members to attend and the social and educational advantages that it affords are unsurpassed.

The New Deputies.

Supreme Chief Engineer of the A. O. S. E., Hiram M. Trout, has appointed the following Deputy Supreme Chiefs: For Philadelphia district, Frank J. Cannon, 709 N. 44th St., West Philadelphia, Pa.; for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.; for New Jersey, Joseph P. Whitley, 421 So. 5th St., Camden; for Wisconsin, Henry A. Nothbohm, 1352 Second St., Milwaukee; for Massachusetts, E. H. Naylor, Box 446, North Abington; for Maryland, Thos. E. Eaton, 2811 Hudson St., Baltimore; for Delaware, E. Clark Franklin, 1022 Wawassett Ave., Wilmington.

The Coming Omaha Convention of the I. U. S. E.

The Eigthth Annual Convention of the International Union of Steam Engineers will convene in Washington Hall, Omaha, Neb., Monday, Sept. 12, 1904, and continue for ten days.

The International Exhibitors' Association have secured spacious quarters in the same building for their Exhibition Hall and are making elaborate preparations for the exhibition. For information regarding space, etc., address L. G. Vogel, World Building, New York.

Massachusetts State Convention N. A. S. E.

The Ninth Annual Convention of the Massachusetts State Association, N. A. S. E., was held at Lynn, July 8th and 9th, and proved a most delightful affair. Nineteen association were represented by delegates and there were a hundred or more visiting members and friends from all parts. There were also a large number of supply men who helped to make things lively.

The report of Secretary W. N. Beal showed a membership of 1250.

The report of Treasurer Walter H. Damon showed a substantial balance in the treasury.

There was considerable discussion over the license law, some upholding the present law and other delegates denouncing it and urging that it should be improved. The most serious objection to the present State low was the claim that graduates of Boston engineering schools without experience often received licenses of the first or second class after three or four months' study. Some minor changes in the constitution were recommended, but it was decided not to change the per capita tax.

The election of officers for the ensuing year resulted as follows: President, W. E. Bradbury, of Lawrence; Vice-President, Fred. L. Johnson, Lynn; Secretary, Ole B. Peterson, Boston; Treasurer, W. H. Damon, Springfield; Conductor, A. D. McAuley, Springfield; Doorkeeper, J. E. Whittemore, Roxbury.

Retiring President Chas. E. Blodgett was presented with a handsome gavel, the presentation address being made by Jas. Duncan.

W. E. Bradbury.
President, Massachusetts State Association N. A. S. E.

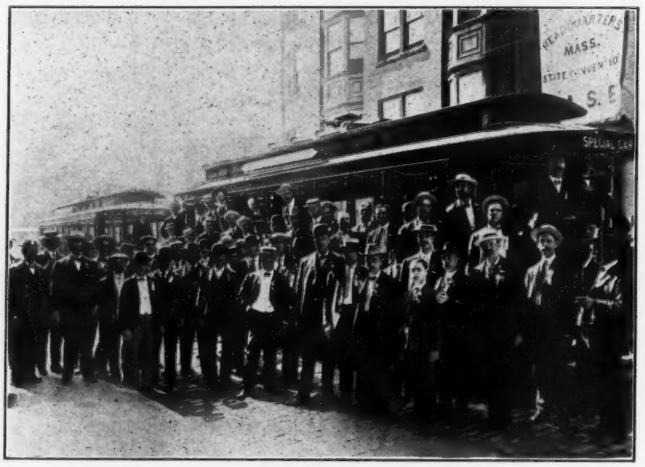
The new license committee is composed of R. R. Bradbury, J. N. Kelsey and J. A. Nutter.

After the close of the convention, the delegates visited the General Electric and River Works and were taken for a sail through the harbor and along the shore.

In the evening, a banquet was served at which 200 guests were present; the menu was excellent and there were several good speeches. Fred. Johnson made an efficient toastmaster. Among the speakers were Mayor Eastham, Howard K. Sanderson, Chas. F. Prichard, Thos. P. Burke and J. N. Kelsey.

Supply Men.

The representatives of engineers' supply houses attended the Lynn Convention in force and a more agreeable lot of fellows would be hard to muster. The following firms were represented: Ftichburg Steam Engineer Co., Lagonda Manufacturing Co., Hart Packing Co., Philadelphia Grease Manufacturing Co., Curry Oil and Supply Co., Greenwood & Daggert Co., A. W. Chesterton & Co., Patterson Lubricating Co., Knowlton Rubber Co., A. W. Harris Oil Co., American Steam Gauge and Valve Co., Mason Regulator Co., Ashton Valve Co., Crosby Steam Gauge and Valve Co., Garlock Packing Co., Penna. Electrical and Railway Supply Co., Quaker City Rubber Co., American Steam Packing Co., Jenkins Bros., Dearborn Drug and Chemical Works, New England Roller Grate Co., H. S. Peters, Brotherhood Overalls, and W. A. Harris Steam Engine Co.



Group of delegates at Lynn Convention
Massachusetts State Association N. A. S. E.

Scalded by Escaping Steam. Effect of Water Hammer.

An accident that was probably due to water hammer recently occurred in the basement of an office building in Philadelphia, and John McGrath, the fireman, almost lost his life by being scalded with the escaping steam.

A large 6-inch steam main led from the boiler to one of the engines. Near the engine was a 6-inch tee which reduced to three inches in the cross directions. One of the three-inch openings was connected to a pipe used for steam heating in the restaurant above. It was the duty of McGrath to turn on the steam at this point every morning. At the time the accident happened, he was turning on the steam and the condensation in the pipe rushing through with the steam hit the tee a hammer blow which it could not withstand and it broke in half. The escaping water saturated McGrath and it was only by a miracle that he escaped sudden death. The boiler was emptied of its water before the valve could be closed and the engine and dynamos were more or less injured by it.

An interesting account of this same accident was in the newspapers an hour after it happened, as follows:

"John McGrath's life will probably be the price of his bravery, but he will die a hero. By his single-handed courage

and self-sacrifice McGrath prevented an explosion of steam in the basement of a big Chestnut street building this morning, and probably saved the lives of a dozen girls who were in the place at the time.

McGrath, who lives at No. 1136 Washington street, is employed as fireman at No. 1208 Chestnut street. The first floor and basement are occupied by one of Childs' restaurants, and the upper floors as offices.

Down in the engine-room McGrath was working about 7 o'clock this morning, when he heard a sharp, hissing noise. To his trained ear the sound was ominous. It meant that one of the steam pipes had sprung a leak and if not checked within a few seconds a disastrous explosion was inevitable.

McGrath's thoughts were on the imperilled women on the floor above him, ignorant of the danger menacing them. Without an instant's delay he made his way to the point whence the ugly curl of white smoke proceeded. With might and main he attacked the leak. Scalding water was dripping in a constant stream, and the bared arms of the fireman were red and blistered in an instant. He strove valiantly to plug up the leak, although every moment was one of indescribable torture. Human lives depended upon his quickness, and, disregarding the agony that was momentarily increasing, McGrath toiled on until he sank unconscious from pain beside the defective pipe.

He had succeeded in preventing the explosion he dreaded, but at the probable cost of his own life.

Clouds of scalding vapor enveloped him, and from head to foot he was almost parboiled. Other workmen, seeing the steam-smoke arising from the cellar, made their way to the engine-room. They found McGrath lying senseless where he had fallen.

A telephone call brought the Jefferson Hospital ambulance around at a gallop, and McGrath was conveyed to that institution. A glance showed the physicians that the brave fireman had practically no chance for recovery. His flesh was almost boiled from the bones in places and was raised in great blisters at others. He was suffering excruciating pain, and it was also thought he had sustained internal injuries. His death, they state, is only a matter of a short time."

Economy of the Horizontal Tubular Boiler versus the Water Tube.

EDITOR THE PRACTICAL ENGINEER:

The enormous demand that has arisen within the last few years for the water tube boiler has, beyond a doubt, impressed the steam using public with the idea that the water tube boiler is preeminently superior in economy to that of the horizontal tubular boiler. We see large power stations and electric lighting plants disposing of their horizontal tubular boilers (that might be considered at the moment of disposal to be in a fine working condition) because of the economical results to be derived from the use of the water tube boiler. At first sight, we would be led to believe that the replacing of the horizontal tubular boiler was an actual business necessity owing to the large amount of fuel and labor saved from the use of steam boilers of the water tube type. Indeed, one of the strongest arguments put forth in favor of the water tube boiler is, that it uses less fuel per unit of work when compared with the amount of fuel used by the horizontal tubular boiler. Now that the use of the water tube boiler has become almost universal in large power stations, we would find an almost insurmountable barrier placed before us providing we should suggest that all those expected economies have not been realized from its use. The safety of the water tube boiler from explosion is also used as an argument to effect the removal or displacement of the horizontal tubular boiler. Mathematical demonstrations are cited to show that the water tube boiler is practically safe from explosions. In other words, higher pressure can be carried on boilers of the water tube type than on boilers of the horizontal tubular design. However, it will be admitted that the horizontal tubular boiler can be built to withstand pressure sufficiently high for our present needs and that considering the great number of horizontal tubular boilers in use together with the length of time in actual operation, plus poor attendance, we may safely consider boilers of the horizontal tubular type as practically safe.

The horizontal tubular boiler may be considered more economical in the following ways: 1. It is easier to clean and maintain free from scale, ashes, etc. 2. It is cheaper to open for inspection. 3. It is cheaper to install. 4. Its longevity surpasses that of the water tube by many years. 5. The brick work and general maintenance are more easily and cheaply repaired since there are no "deflecting arches," etc., to be kept in a working condition. 6. The heating surfaces of the heads are included, while this important factor is almost practically eliminated from the water tube type. 7. The fluctuation of steam pressure and water level is far less. 8. The horizontal tubular boiler is free from the inherent defects of the water tube because the water tubes or pipes lying in a slanting position over the fire become flat on the sides after a few years of continuous service and this defect adds materially to the first cost. We say first cost because the repairs follow so quickly after installation that this cost or expense may be added to the first cost.

With respect to opening the water tube boiler for inspection, it is clear that the buying of gaskets for numerous handholes entails a large expense. Let us assume that our water tube boiler contains 122 tubes. We see from this that we must buy 244 handhole gaskets and at least one manhole gasket and assuming we buy our gaskets at first cost, one opening will cost us $20.27 without considering labor. Now it is clear that one opening will not be sufficient during the year. Suppose we open the water tube boiler four times in one year. Then, considering labor at $2.00 per day, the expenses will be equal to $97.08, assuming the water tube boiler lasted for ten years, we see the expenses involved in keeping it clean would amount to $970.80. In considering the cleaning of the horizontal tubular boiler at the rate of four times per year it will cost at the utmost, $12.00, assuming labor at $2.00 per day during the operation of cleaning. Hence we see that the expenses incurred by the water tube boiler in only keeping it clean, amounts to more than eight times as much as that required by the horizontal tubular boiler. With respect to the saving of fuel for which the water tube boiler is so loudly accredited, the writer could not detect any saving over that of the horizontal tubular boiler all things else being considered equal.

Brooklyn, N. Y. W. K.

TRADE NOTES

Homestead valves possess individual points of merit which usually interest men of a mechanical turn of mind. These features are described and illustrated in a neat little catalogue which the manufacturers will mail to readers of The Practical Engineer upon request. Address Homestead Valve Mfg. Co., Box 1754, Pittsburg, Pa.

The best posted men of our time are those who read advertisements most carefully. If you want to test this statement, take a copy of The Practical Engineer or of any other mechanical or trade journal, and read every advertisement in it, making notes as you go of those things which are new to you and which interest you. The number of notes and the knowledge thus gained will surprise you. Catalogues, circulars and other advertising literature are also full of valuable information, and, what is better, they may be had in endless variety without charge.

The American Water Softener Co. report that they have sold a large number of machines during the present year, some of the machines in the present vicinity being those of the Jenkins Rubber Works, Elizabeth, N. J.,; Heine Safety Boiler Works, Phœnixville, Pa.; Philadelphia Pneumatic Tool Co., Philadelphia, and Sauquoit Silk Mills, Philadelphia.

A can of Albany Grease, with an Albany Grease Cup will be sent free of charge or expense to any reader of The Practical Engineer who desires to give it a trial. Address Adam Cook's Sons, 313 West street, New York City.

A booklet which treats of water softening for boiler feed will be mailed free to any one mentioning The Practical Engineer. Address American Water Softener Co., Harrison Building, Philadelphia.

If you had been a good guesser you might have won one of the prizes of gold that were awarded last month by James L. Robertson & Sons to the person guessing nearest the number of admissions to the St. Louis Exposition on July 4. If you watch the Robertson ads you may see other interesting propositions from time to time.

Mr. Robert Gregory delivered an address on mechanical methods of cleaning boilers, before Keystone Association N. A. S. E., Pittsburg, at a recent meeting. Mr. Gregory is an engineer of long experience, and his address covers the subject in considerable detail. It is published in neat form, and Mr. Gregory will send copies of it to any one who will drop him a card at 112 Wood street, Pittsburg, Pa.

H. B. Underwood & Co. completed an engine job the early part of July which, for size and promptness in finishing, seems to beat all records. They received an order to repair a compound engine as follows:

Furnish and fit a new 44-inch and a new 25-inch adjustable pistons complete with new rods and St. John Self-Adjusting Cylinder Packings, new valves and stems and complete new valve motion on both cylinders, new crossheads and shoes and wrist pins and rod packings and dash pots; and they finished the job and had the engine running in twelve days after receipt of order. Next.

The Chaplin-Fulton Mfg. Co., of Pittsburg, Pa., manufacturers of the Vigilant Feed Water Regulator and a system of automatically feeding water to steam boilers so as to keep the water level constantly at the middle gauge, have placed the agency for the New England States with D. W. Patterson, Mechanical Engineer, Harrison Building, Philadelphia, Pa.

Mr. Patterson has been their Philadelphia agent for a number of years and will retain his present territory. An office has been opened at 30 Oliver street, Boston, with Mr. William Lancaster in charge as manager to handle the New England work. The latter is well known as having been connected with the selling agents of the Cochrane heater in Boston.

The Keystone Lubricating Co., of Philadelphia, manufacturers of the well-known lubricant, Keystone Grease, announces the opening of a Boston agency for the convenience of trade adjacent to and in Boston.

Mr. Herbert Carpenter has been appointed general agent for the territory.

This item is more or less interesting as illustrating the rapid growth of a concern which by manufacturing a high grade product won substantial support and recognition from engineers for having done much to solve difficult problems in lubrication.

Braman, Dow & Co., Boston and Worcester, Mass., have recently secured the agency for the H. H. Steam Trap, manufactured by James McCrea & Co., Chicago. These traps are guaranteed to give absolute satisfaction to the user, and on account of their simplicity and reasonable price should be investigated by every one that uses traps.

The Chaplin-Fulton Mfg. Co., of Pittsburg, Pa., have recently issued two well-illustrated catalogues describing the Vigilant Feed Water Regulator and the Fulton Pressure Regulator with Automatic Cut-off.

The Vigilant Regulator has been on the market the past six years, on boilers of every type and under all conditions. By means of this simple apparatus the water level in the boiler is kept at a fixed point, usually the middle gauge, irrespective of the load or firing of the boiler, and the water admitted a little at a time in exact proportion to the amount of steam produced. This insures economy of fuel, dry steam, durability of the boiler, and is a safeguard against explosions. The Fulton Pump Governor when set for any given over-pressure will maintain the same without variation and without further adjustment, regardless of how the boiler may be feeding. It is used in connection with the above regulator.

The Fulton Pressure Regulators are specially designed for the safe and economical distribution and regulation of natural gas in private dwellings, mills, factories and street mains; and for controlling of the steam pressure and gas fuel supply to steam boiler and the reduction and regulation of steam pressure. These useful catalogues can be had for the asking.

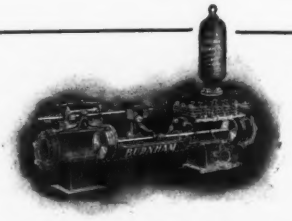
The well-known firm of James L. Robertson & Sons, New York, manufacturers of Eureka Packing, Robertson-Thompson Indicators and many other useful steam specialties, in their desire to keep themselves and their goods before the public, started in February last a guessing scheme, offering three prizes—$200, $75 and $25 in gold—to the engineers who guessed nearest to the number of admissions to the St. Louis Exposition on July 4th.

Naturally, there were a great number of contestants.

On receipt of the official figures from the Secretary of the Exposition—namely, 179,258—a committee, composed of the publishers or managers of the five most prominent engineers' papers, examined the records and awarded to the following gentlemen:

Joseph Carson, Engineer for the Pennsylvania R. R. Co., Market Street Station, Newark, N. J., who guessed 178,986, first prize.

Mason Chilcote, Engineer, American



Union Steam Pump Company

BATTLE CREEK, MICHIGAN

Manufacturers of the

GREAT BURNHAM

STEAM PUMP

The Pump that won't short Stroke.

Sewer Pipe Co., Akron, Ohio, who guessed 179,738, second prize.

Albert Schmith, Engineer, American Multiple Fabric Co., Providence, R. I., who guessed 180,210, third prize.

The bags of gold have been sent forward to these persons, and no doubt satisfactory acknowledgment of same will be returned.

It is pleasant in this age of catchpenny prize schemes to note this substantial offer and the conscientious carrying out of same in a prompt manner.

A catalogue issued by the Magnolia Metal Co., 113 Bank street, New York, possesses more than ordinary merit. It not only describes the uses of this important and well-known metal, but it contains a large amount of general information. Mention The Practical Engineer when writing for one.

An interesting circular and one which is somewhat different from any which we have seen is being distributed by the Foos Gas Engine Co., of Springfield, Ohio. It brings out clearly the advantages of this type of engine, and should be obtained by any one interested in the gas engine problem.

There is no valve in existence that has given better service than the Corliss Valve. Mr. John T. Linstrom, of Allentown, Pa., has taken advantage of this fact and embodied this principle in his Steam Trap. No one interested in steam traps should fail to investigate the advantages of this trap.

Boiler Compound is a term applied to a preparation made for the purpose of removing what is known and termed as scale, which is an incrustation on the inside of a boiler on the submerged or water covered surfaces. The Dearborn Drug and Chemical Works, Rialto Building, Chicago, are experts at removing this scale. In boilers which are badly coated with incrustation, the Dearborn method cleans them as clean as a whistle. It is only necessary to send a gallon of water to them, and they will give you a receipt which will do the work. A pamphlet describing the "Treatment of Boiler Feed Waters" is well worth having, and a card to them will bring it to you.

WANTED. Local agents in all parts of the Country to sell WILLIAMS STEAM SPECIALTIES. All familiar and connected with power plants can largely increase their income. Many are building homes by selling our goods. Engineers and others are doubling their incomes in their spare time. **Our goods reduce fuel bills,** and appeal strongly to those who pay the bills, and repeated orders is **the rule.** Write us at once for full information.

THE WILLIAMS GAUGE CO.
543 Fourth Avenue - - Pittsburg, Penna.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics.

JOHN T. LINDSTROM,
214 and 216 S. 3d St., Allentown, Pa.

Oil vs. Grease. Who can answer which is better to use? An interesting discussion of this subject can be found in a catalogue just issued by the Joseph Dixon Crucible Co., of Jersey City, N. J., which not only takes up this important subject, but explains clearly the uses and methods of using graphite in many important ways. Write for "Oil vs. Grease."

Mr. W. F. Warden, president of the Burt Mfg. Co., Akron, Ohio, has just returned from a trip abroad, having visited England, France, Germany, Switzerland, Norway, Sweden, Italy and Spain, calling upon the regular agencies of his company, and establishing new ones. He reports a profitable trip. He also combined pleasure with business, and visited all the points of interest to tourists.

The B. F. Sturtevant Co. announce the removal of their entire plant from Jamaica Plain to their new works at Hyde Park, Mass., where, with nine acres of floor space and all modern appliances, they will continue to manufacture the well-known Sturtevant products.

The A. W. Harris Oil Co. is one of the oldest and best-known lubricating oil houses in the country and Harris Oils are rapidly coming to be recognized and appreciated for their genuine merit. Send for a copy of "An Oily Tale" and learn more about them.

THE BURT EXHAUST HEAD
even under the severest strain
STANDS THE TEST.

It is the strongest, most durable, safest and most reliable head on the market.
It prevents water and oil issuing from the exhaust pipe.
"The Burt Exhaust Head serves its purposes admirably and is giving entire satisfaction"—Edison Storage Battery Co., Glen Ridge, N. J.

THE BURT MFG. CO.
Largest Manufacturers of Oil Filters in the world.
204 Main St., Akron, Ohio, U. S. A.
Also supplied by Oil Companies, Engine Builders, Dealers, and Power Contractors.
FAIRBANKS CO.
Sole Agents for Philadelphia.

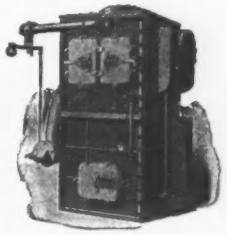
FLAKE GRAPHITE HAS ALWAYS CURED FRICTION TROUBLES

Write for a copy of Dixon's newest Publication

"Graphite as a Lubricant"

and learn the possibilities of Graphite Lubrication.

JOSEPH DIXON CRUCIBLE CO.
Jersey City, N. J.



How Hot Is Your Feed Water?

What is the temperature of the feed water entering your boilers?

Is it about 210°, which is easily obtainable with a Cochrane Heater operating under proper conditions, or does it fall way below that mark?

In no way can an engineer better serve his employers than by investigating such things as this in the steam plant. Surely the temperature of the feed water is worth noting, since for every 10° this temperature falls below 210° one per cent of all the fuel is being wasted, assuming that there is exhaust steam available for heating the water. If you are getting but 160° you have the opportunity of showing your employers how they could make a clean saving of 5 per cent of their coal bill. This may mean increased earning power for you, and it will certainly save you labor in handling coal and ashes and in cleaning the boilers.

We will be glad to tell you exactly what a Cochrane Heater would do in your plant, and we will send you a catalogue describing these Cochrane Heaters if you will advise us what temperature you are getting, the type of heater used, and the amount of exhaust available, etc.

HARRISON SAFETY BOILER WORKS
3144 N. 17th Street
PHILADELPHIA, PA.

Manufacturers of Cochrane Feed Water Heaters, Cochrane Steam and Oil Separators and the Sorge-Cochrane Systems.

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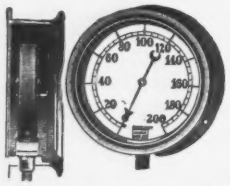
"STANDARD" SELF CONTAINED GAUGE



We claim particular merit for our gauges and mention several of the numerous points of superiority.

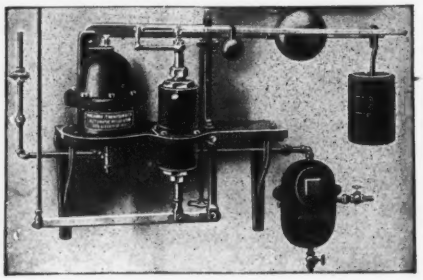
Mechanism is independent of case.

Material used is selected on account of having wearing qualities that will outwear two gauges of stock generally used.

They are non-corrosive, attractive and accurate.

Send for our catalogue, which illustrates and describes Gauges of our manufacture for all known purposes; Engine Counters, Clocks, etc.

STANDARD GAUGE MANUFACTURING CO.
107 N. Franklin Street, Syracuse, N. Y., U. S. A.
New York Office, 141 Broadway Chicago Office, 58 Washington Street
PACIFIC COAST AGENTS,
Geo. H. Tay Co., San Francisco and Los Angeles, Cal., Seattle, Wash.



The Thompson Damper and Pressure Regulator with latest improvements, insures uniform steam pressure and must

SAVE COAL.

Indicators, Reducing Wheels, Planimeters, etc.

The Soot Ejector and Injector Blower, Boiler Tube Cleaners. Shaking, Dumping and Stationary Grate Bars.

RICHARD THOMPSON & CO., Sole Manufacturers
128 LIBERTY STREET NEW YORK, N.Y.

There Must Be Some Reason

WHY

Homestead Valves

are demanded in all four quarters of the globe

We will impart the secret to you. They are higher priced and very much better than the ordinary kind for all *HARD-TO-FILL* places.

Write for Booklet No. 10, just issued.

Homestead Valve Mfg. Co.

Box 1754, Pittsburg, Pa., U. S. A.

Works at Homestead, Pa.

Everyone knows

that Automobile Tires are made of the finest grade of Para Rubber. We have been using the Scrap or Waste from these tires to make a special grade of fine

SHEET GUM

"Auto" Packing

20 cents per pound

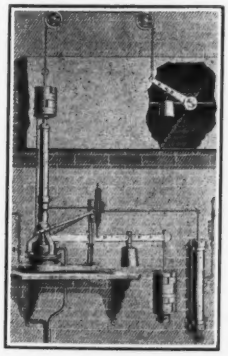
For hydraulic and low pressure steam joints, gaskets, etc. It is press cured material, natural gray rubber color, cloth insertion, all thicknesses. Why pay 50 cents per pound for fancy packing? Send for sample.

SAŸEN & SCHULTZ

MECHANICAL RUBBER WORKS

13th & Commerce Streets

PHILADELPHIA, PA.



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Regulators for Sugar Refineries, Paper Dryers, Drying Cans, Dye Houses

We Succeed Where All Others Fail

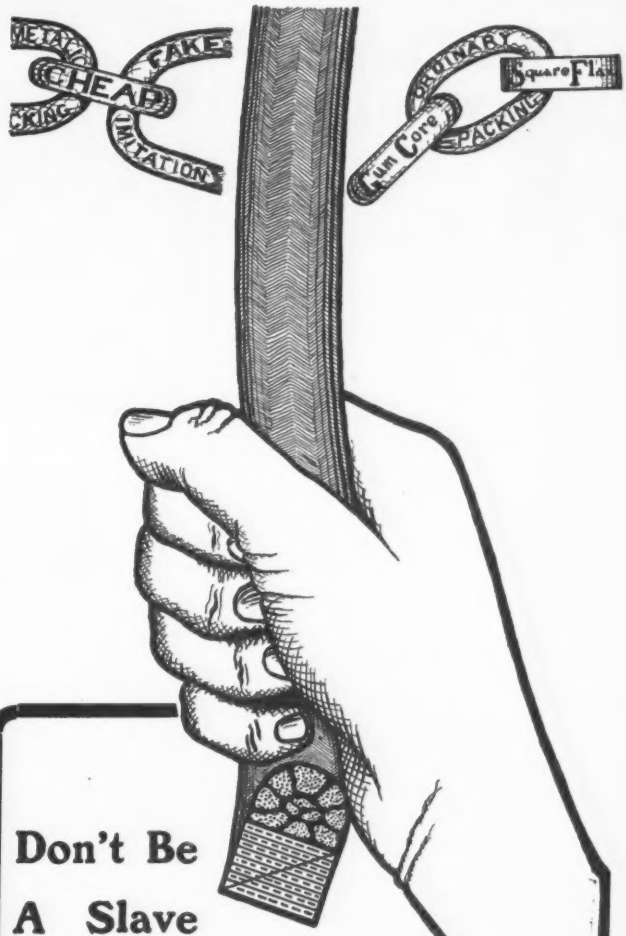
Catalog Upon Application

Prices Greatly Reduced

Sent Anywhere on Thirty Days Trial

Wm. E. Benson & Co.

1001 Chestnut St. PHILADELPHIA, PA.



Don't Be A Slave To Poor Packing

The dirty disagreeable work of packing the stuffing box need not be an every week occurance. P. P. P. is made on different lines from any other packing on the market, and as a result it lasts many times longer. The fact that P. P. P. is not ground to pieces in a short time like ordinary packing proves that you should

USE P. P. P.

to reduce friction on the rod to the minimum. The following letter tells how one user avoided the disagreeable task of repacking 22 times. You can do the same.

Michigan City, Ind., Oct. 27, 1902.

QUAKER CITY RUBBER CO.
201 Madison Street, Chicago, Ill.

Gentlemen:—

I am sending you a ring of P. P. P. Packing which has been in use on our 22 x 42 Corliss engine for a period of 11 months and 10 days. Before using P. P. P. Packing, this engine required repacking every 2 weeks, using 4 pounds at each packing.

Wishing you continued success, I am.

Very truly yours.

R. B. CROCKETT, Chf. Eng.
Indiana State Prison.

SEND IN THE COUPON TO-DAY

The Quaker City Rubber Co. Philadelphia.

Gentlemen: Please send me your booklet proving that P. P. P. will save work.

Name _____

_____

St. and No. _____

City _____ *State* _____

Occupation _____

Employed by _____

Practical Engineer

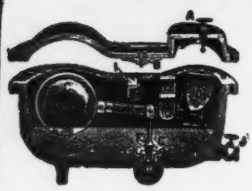
The Tornado Boiler Tube Cleaner

Requires **LESS** steam than any other cleaner.
Will positively clean **BETTER** than scraper or brush.
Will clean **ANY** ength tube.
In operation **EQUALLY** balanced, insuring **NO** back pressure against operator.
Is the **LIGHTEST** and **EASIEST** cleaner to handle.
Has **NO** working parts.
Its force is tremendous.

Manufactured by

Paul B. Huyette

1245 Betz Building
Philadelphia



McDaniel Steam Traps

Always have a Water Seal over the valve and never blow steam; neither do they back up water

REDUCING VALVES
EXHAUST PIPE HEADS,
EJECTORS, RELIEF VALVES,
GREASE EXTRACTORS,
STEAM SEPARATORS, etc.

Watson & McDaniel Co.

MANUFACTURERS

Send for 1902 Catalogue

147 N. Seventh Street

For sale by the Jobbing Trade

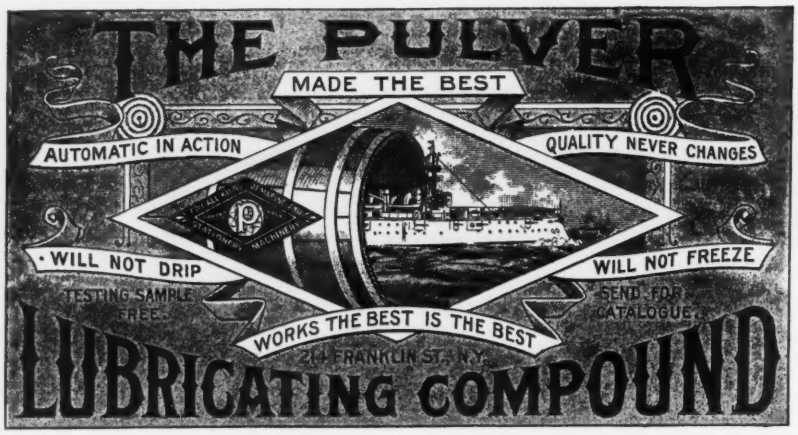
CRANE VALVES

ESTABLISHED 1855

Steam Coal a Specialty **Telephone Connection 2-25-60**

A. CRAWFORD COAL

1829-1833 N. Tenth St., Philadelphia, Pa.



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FOR

The Practical Engineer

is easy, it pays too, and moreover you have the satisfaction of knowing that you are giving each subscriber the best valve that he ever purchased for fifty cents.

The Practical Engineer is admitted to be the largest and best engineers paper ever published anywhere in the world for fifty cents a year.

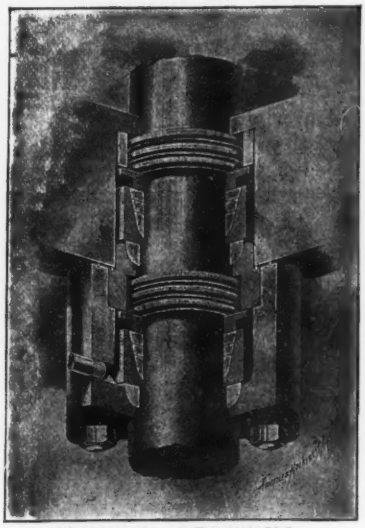
Kieley's Cantilever Expansion Steam Trap

Discharges against pressure—operates in any position; will not become air-bound; never freezes: simple in construction; durable, light, and easily adjusted. Guaranteed under any and all conditions. **Send for Catalog**

Tell us about it and the many superior points of other up-to-date steam appliances we make

KIELEY & MUELLER
34 West 13th St., - New York

JAMES J. ROGAN
810 Race St., Philadelphia



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UNITED STATES
Piston Rod and Valve Stem
PACKINGS

Do their work well.
Their use will save you considerable money and endless trouble.
We can present convincing proof of their worth.

SEND FOR CATALOGUE AND PRICES

The United States Metallic Packing Co.

MAIN OFFICE AND WORKS:

509 Great Northern Building
CHICAGO, ILLS.

No. 427 North Thirteenth Street.
PHILADELPHIA, PA.

Dirty roofs and walls give your plant an unbusiness like appearance.
Neatness in this respect can be secured at a comparatively small expense.

The Sterling Exhaust Head
Will do it Perfectly

No back pressure on your engine.
All the water and grease in the steam entrapped and drained to any desired point.

WE PREPAY THE FREIGHT.
YOU RETURN THE HEAD IF NOT AS REPRESENTED

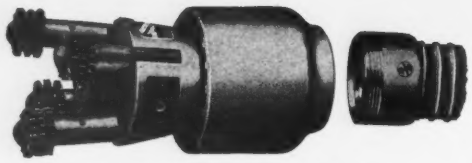
Sterling Pipe and Blower Company
HARTFORD, CONN.

YOU'LL DOUBTLESS BE GOING TO

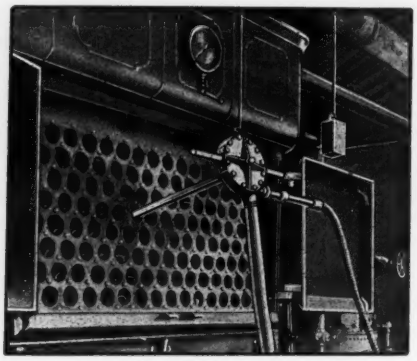
The St. Louis Exposition

and if interested in Boilers and Boiler Tube Cleaners
will want to see **THE BEST,** and that is of course

THE WEINLAND



No. 8 Turbine, Patented.



Direct Motor, Patent Applied For.

You'll find it on Exhibition in Steam, Gas and Fuel Building, where different types can also be seen at work on the several styles of boilers (40,000 H. P., U. S. and Foreign make) there used for supplying steam for power and other purposes for the entire Exposition.
Don't fail to call at our space ; make yourself at home ; rest your body and watch our cleaners

DEMONSTRATE THEIR SUPERIOR MERIT IN ACTUAL WORK.

You'll also find at our Exhibit a full line of our Boiler Room and Steam Specialties, and we'll have a souvenir for you. too.

The Lagonda Mfg. Co.,

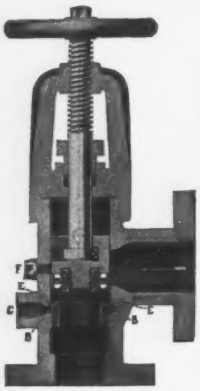
Boiler Cleaning Experts,
SPRINGFIELD, OHIO.

Boiler Tube Cleaners
Blow-off Valves

The Liberty Turbine Boiler Tube Cleaner

will clean tubes more thouroughly, at less cost, and in less time than can be done by other means.

This we guarantee.



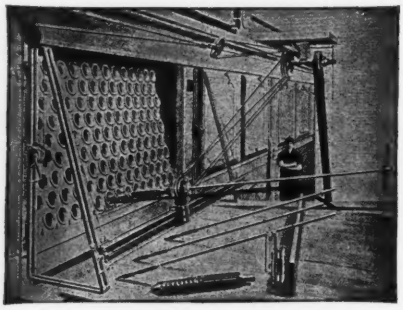
We also make the **Niagara Turbine Tube Cleaner.** We have suit for infringement of patents against a user of the Weinland machine, and will sue all other infringers

The Faber Blow-off Valve

washes its face every time it is opened and closed.

A connection at C admits steam at boiler pressure to chamber B, whence it escapes through slot E all around the seat, and sweeps both seat and disk free from sediment just before closing. It will last as long as a steam valve without leaking.

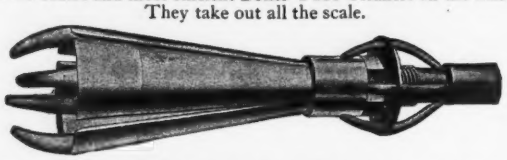
Liberty Manufacturing Co.
6907 Susquehanna Street - Pittsburg, Pa.



The Union Boiler Tube Cleaners

POWER OR IMPULSE

Are the oldest and most efficient Boiler Tube Cleaners on the market. They take out all the scale.



The Gem Flue Scraper

does the same for Smoke Flue Boilers

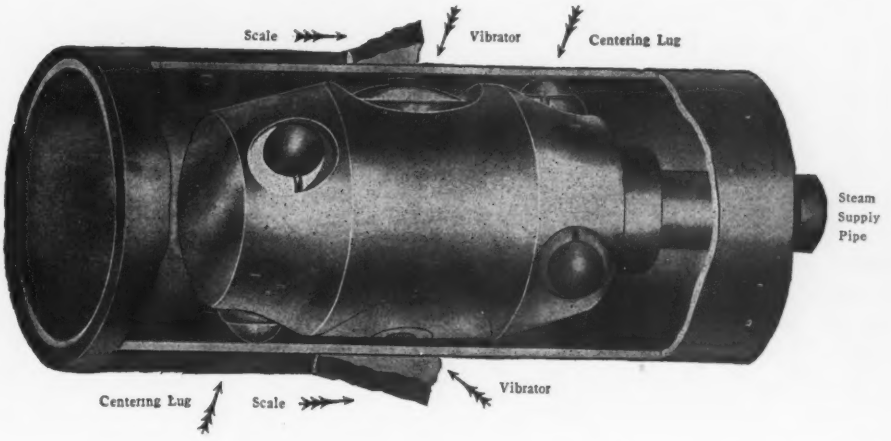
We also make **Gem Oilers,** Patent or Plain, **Torches and Heavy Brazed Steel Oilers, Flexible Shafting, Loose Pulley Lubricator.**

Write for Catalogue and Prices.

Gem Manufacturing Co.
Spruce near 33d Street - Pittsburg, Pa.

Don't Hammer the Tube---Vibrate It.

It isn't at all necessary to pound the life out of a tube in order to remove the scale from fire tubes. That idea exploded with the invention of the "Torpedo". Short, light taps of infinite rapidity produce a vibration which causes the scale to peel off the tube easily and quickly. THE METAL OF THE TUBE IS NOT STRAINED BEYOND ITS ELASTIC LIMIT, so the tube is not expanded. There is no brutality about it.



Moreover we guarantee that the "Torpedo" will save its cost in fuel in not over six months. In other words a return of 200 per cent. on the investment. Can you afford to pass by this proposition when we will loan you a "Torpedo" for a free trial in your boiler?

We now manufacture these for the smallest sized tubes such as are found in locomotives, threshing boilers, Berry boilers, small vertical and horizontal boilers. Our illustrated booklet explains more about it, but a trial in your boilers will tell the story.

THE GENERAL SPECIALTY CO.

75 CARROLL STREET, BUFFALO, N. Y., U. S. A.

We and our predecessors have made Red Star Boiler Compound for over twenty years.

We have done nothing bu make Red Star, except to sell it. We have had many and various experiences with different conditions. Sometimes we have made mistakes. These we have profited by.

Other times we made successes. These we have adopted and improved.

To-day we can say that we know the boiler compound business up to date. Next year we will know more, if there's more to know. Now and at all times the benefit of our experience is yours for the asking.

Send for our new 96 page booklet. IT'S FREE.

LAKE ERIE BOILER COMPOUND CO.

CHICAGO STREET BUFFALO, N. Y.

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CINCINNATI, 70 Mitchell Building
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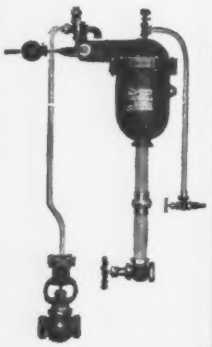


INSTALL THE

Vigilant Water Feed Regulator

SAVE FROM 3 TO 15 PER CENT. IN FUEL

Let us send you a list of users that you may investigate. Write

CHAPLIN FULTON MFG. CO.

32 PENN. AVE. PITTSBURG, PA.

When considering the purchase of a STEAM TRAP, bear in mind that the

H. H.

is more reasonable in price and less liable to get out of repair than others, and is sold with a guarantee to give absolute satisfaction.

JAMES McCREA & CO.
Manufacturers
67 W. Washington St., CHICAGO

YOU CAN'T LOSE--

Our plan is so simple and fair and square that you can't lose.

Universal Belt & Pulley Reg. Co., New York — Brooklyn, Mar. 15, 1904.

GENTLEMEN:—The covering which you put on our pulleys at our factory, 28 & 30 Rodney Street, Brooklyn, has proved eminently satisfactory. Prior to its being put on one of the motors which drove the line shafting had to be set at an angle in order to keep the belt on the pulley. Since the application of your covering the motor has been squared up and is running perfectly straight.

We take great pleasure in recommending the covering. Yours truly,

WATERBURY & CO.—Per Geo. W. Nock.

THE UNIVERSAL BELT AND PULLEY REGULATOR

is sold on a thirty day trial. Can anything be fairer than that? **It is guaranteed to last five years. Pulleys re-covered free of charge if worn off before end of time started.** For either iron or wooden pulleys. It's to prevent slipping too. Send us the size of the pulley you wish to cover and we will give price of work complete.

235 Lexington Avenue, Universal Belt and Pulley Regulator Co. NEW YORK CITY

Lindstrom's CORLISS VALVE STEAM TRAP

A GREAT EMERGENCY TRAP

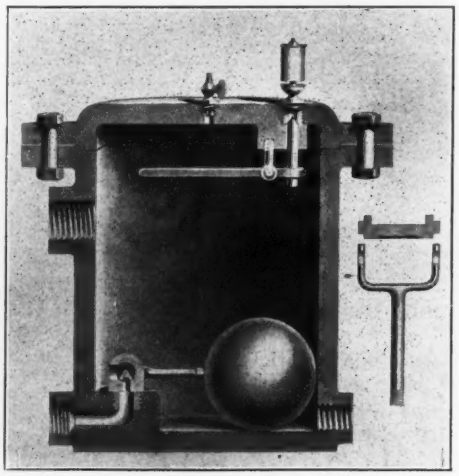
No packing of any kind required, the cover being ground.

The Corliss Liberating Valve. Always on seat. No scale or grit can get between this valve and seat.

An automatic alarm whistle. A great feature.

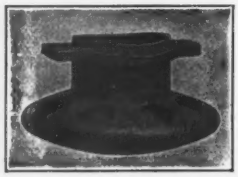
No pins or screws used in connecting the valve mechanism.

The centre of the valve being the fulcrum, gives the float great lifting power.



Cylinders Rebored

All types and sizes of Steam Engine Cylinders, Valve Pockets, Pumps, and Air Compressors Rebored in present position, from 4 to 76 inches.



Separator

That will keep the water in the boiler. Impossible to get water over to the engine cylinder.

John T. Lindstrom

214, 216 S. Third Street, Allentown, Pa.

THE EUREKA PRIZE WINNERS

SECOND PRIZE

Akron, Ohio, July 12,1904

Gentlemen:—

I have just arrived from the bank with $75.00 in GOLD in a bag. The second prize in the Guessing Contest, and to say I am delighted does not do justice to the occasion. When I saw it I thought it too good to be true. I say "EUREKA" in every sense of the word.

Respectfully yours,
Mason Chilcote, Engr.,
Am. Sewer Pipe Co. Fact'y 27.

FIRST PRIZE

Newark, N. J., July 12, 1904.

Gentlemen:

Received this day from Jas. L. Robertson & Sons, a bag containing $200.00 in GOLD which has been awarded to me as first prize in the St. Louis Guessing Contest. It is needless for me to say that I am much pleased and you can count on me being on hand if you run another such scheme.

Truly yours,
Jos. Carson, Engr. Pa. R. R.

THIRD PRIZE

Providence, R. I., July 11, 1904.

Gentlemen:—

I am much pleased to receive the bag containing $25.00 in GOLD which your letter tells me is third prize in the St. Louis Guessing Contest. It is all right and I am more than pleased to receive it. I am a free user of "EUREKA" and it gives me pleasure to recommend it to any engineer desiring to save himself labor and his employer money.

Yours very truly,
Albert Schmidt, Engr.
Am. Multiple Fabric Co.

Report of Committee on Prizes.

At the request of Messrs. James L. Robertson & Sons, we have inspected the official report of the number of admissions to the St. Louis Exposition on July 4th. and find it to be 179,258. We have also carefully examined the book of record in which all guesses were recorded at date and hour of receipt. We find the following gentlemen have guessed nearest to the official figures and are entitled to the prizes:—

1st. Prize: Joseph Carson, Newark, N. J. 178,986.
2nd. Prize: Mason Chilcote, Akron, Ohio. 179,738.
3rd. Prize: Albert Schmidt, Providence, R. I. 180,210.

New York, July 8th, 1904.

G. E. SLY,
" Power "
O. R. YOUNG,
" Int. Steam Engineer "
S. E. COLE,
" The Engineer "
M. S. WOODWARD,
" The Nat'l Engineer "
E. W. BARNES,
" The Practical Engineer "

THERE'S NO BETTER FRIEND TO AN ENGINEER THAN "EUREKA" PACKING.

It lightens his labor, keeps the engine clean, and saves half the years expense in increased power, first cost and lasting qualities.

Protect your engine with the HINE ELIMINATOR. Keeps water out of the cylinder and oil out of the boiler.

DON'T PUT OFF GETTING THE INDICATOR YOU HAVE THOUGHT SO MUCH ABOUT.

Write us and find out how easy 'tis to own a good Indicator, how easy the terms are and this applies to the Victor Reducing Wheel and the Willis Planimeter as well.

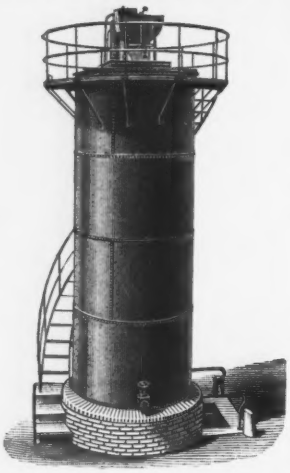
PLEASE VISIT OUR EXHIBIT IN MACHINERY HALL, ST. LOUIS EXPOSITION.

Jas. L. Robertson and Sons,

205 FULTON STREET **NEW YORK**

You Don't Drink

impure water if you can get it pure; then why feed your boilers on a water that is going to lead to a youthful grave and to early gray hairs.



The Water softening plant here shown is assuring a long life for the boilers and rendering the lives of the men about them safer and more enjoyable.

We are always happy when mailing our booklet and figuring on a plant. : : : : :

Western Office

311 Outlook Building, Columbus, Ohio.

AMERICAN WATER SOFTENER CO.,

Harrison Building
Philadelphia

EVERY USER OF POWER AND LIGHT SHOULD READ THE

POWER AND LIGHTING ECONOMIST

tells how to buy best, how to save money, how to improve methods. Thus $1 may save you $1,000. —50c. a copy, $1 a year; Frank H. Knox, Troy, N. Y., and all live newsdealers. Send for great clubbing offer.

BELTING

For Main Driving and General Use
IS A DISTINCT ECONOMY
over any other belting. We will gladly furnish practical proof of this.

MAIN BELTING COMPANY

1219-39 Carpenter St., Philadelphia. 55-57 Market St., Chicago. 120 Pearl St., Boston. 40 Pearl St., Buffalo.

DON'T TURN YOUR BACK

ON THE

Brotherhood Trade Mark Registered Overalls

It's better to protect your back with the Brotherhood High Back Apron. It's the most perfect and best fitting High Back made—Made by the only overall manufacturer who ever wore overalls himself—Made in one of the first Union factories—Made by the manufacturer who originated High Back Aprons. And like all Brotherhood goods, it's absolutely guaranteed.

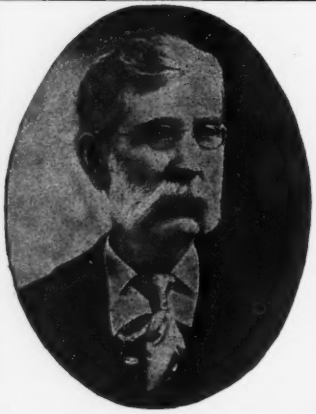
The Sailor Collar overshirt is unusually neat in appearance and beats any kind of overshirt or coat for ease. There are other styles of the Brotherhood Overalls, of course; styles to suit every reasonable desire in overalls, and all the best.

B. L. F. 3 **H. S. PETERS** B. L. E. 171

Manufacturer

DOVER, NEW JERSEY

THE BROTHERHOOD MAN WHO HAS RAISED THE STANDARD OF OVERALLS THROUGHOUT ALL NORTH AMERICA.



J. C. McNELLEY

McNELLEY'S AMERICAN BOILER COMPOUND

Our compound is the result of years of experiments by an engineer of long experience, assisted by expert chemists.

American Boiler Compound not only completely removes all scale and incrustation in the boiler, but prevents new from forming, and will, if properly used, keep the boiler absolutely clean and free from all forms of corrosion, such as pitting, grooving, honeycombing.

Send Sample of Water and Sample of Scale if Convenient.

We will be pleased to hear from engineers who will secure trade for us. When writing for information address

J. McNelley, Dept. Mgr., 35 Poplar St., Phila.

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SMITH, KLINE & FRENCH CO.

429-435 Arch Street, - - - Philadelphia, Pa.

"GLADIATOR" PATENTED

Metal-Face

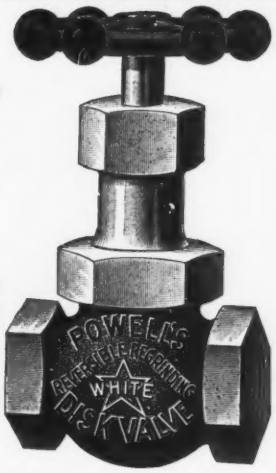
PACKINGS

This represents another of our high-pressure packings. It's composed of metal strips firmly embedded in asbestos.

Like all good things it is imitated, therefore — Remember the "Trade Mark" none other is Genuine.

Powell's "White Star"

Regrinding Reversible Seat Valves



have a longer life and are easier to repair than any valve made.

They are sold with a guarantee of satisfaction or your money refunded.

Try one.

Wrought Iron Pipe

Not Steel

Cut to any size and for any purpose. Prompt Shipments to any part of the world guaranteed

Engineers' Supplies and Steam Fitters' Tools

C. J. Rainear & Co.

No. 518 ARCH ST. - - Philadelphia

CLASS "W" VALVE

NON-RETURN STOP VALVE

PISTON ACTUATED PUMP GOVERNOR

Foster Valve Specialties

Tested and tried under conditions that are far more exacting than demanded of them when in actual use, we prove the reliability of every Foster Valve before it leaves our shop.

Each one of them is a means of economy, a measure of safety in the steam plant.

Class "W" Valve maintains a uniform high delivery pressure regardless of fluctuation in initial or boiler pressure.

Our Non Return Stop Valve will instantly and automatically cut off a disabled boiler from the rest of the battery and a Piston Actuated Pump Governor should be on every steam pump that is not constantly under the surveilance of the engineer.

Every engineer should have a Foster Catalog.—Have you one?

Foster Engineering Co.

NEWARK, N. J.

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HIGH-GRADE

LUBRICATING OILS AND GREASES

PEERLESS Boiler Cleaning Compounds

Our First and Last Consideration is **QUALITY**

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BRICKLAYER and BOILER SETTER

FIRE BRICK WORK A SPECIALTY

BOILER FURNACES RELINED AT SHORT NOTICE

Thomas Sparks

1630 S. 16th Street, Philadelphia.

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If you want the best get Gould's Steam and Water Packing

RING PACKING

In ordering give EXACT diameter of stuffing box and piston rod or valve stem.

See that our name and trademark is on every package.

Gould's STEAM AND WATER Packing

Gould Packing Co.

E. Cambridge, Mass.

REGISTERED TRADE MARK

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There is only ONE

ALBANY GREASE

and we are the only makers

LUBRICATES EVERYTHING

Adapted ta all kinds of machinery

Cost of using oil

Cost of using Albany Grease

Remember, a sample can of Albany Grease with an Albany Grease Cup free of charge or expense for testing.

THIS TRADE MARK ON EVERY PACKAGE. Sold by Engineers and Mill Snpply Dealers the World over.

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It is good enough for any engineer and cheap enough for every engineer.

No where else in the world can a mechanical monthly of such magnitude and excellence be procured for the small sum of

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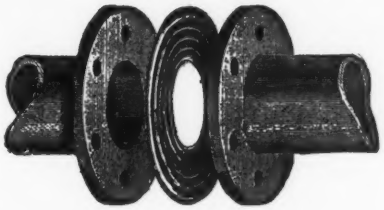
That engineers appreciate this is best shown by the fact that our circulation has grown much more rapidly during the past two years than that of any other engineering journal published.

The Standard Gasket Co.
INCORPORATED



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the Improved Corrugated Copper Gaskets made in any shape, size or thickness, and for all kinds of joints. Lip Unions, Flange Unions, Plain and Ball Joints, Connecting Steam, Air, Gas or Water Pipes, also for Cylinder Heads, Steam Chests, Etc. Guaranteed the best in the market.

We also Manufacture Special Metal Gaskets for all Styles of Water Tube Boilers, Man and Hand-Hole Plates, Mud Drums, Etc., which can be used over many times. We guarantee to save you 50 per cent. on any Gaskets you now use.

Our Copper Gaskets are Hand Rolled, not Hot Pressed. Best and cheapest. Samples Free.

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PHILADELPHIA. PA.

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PACKING
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General Sales Agents

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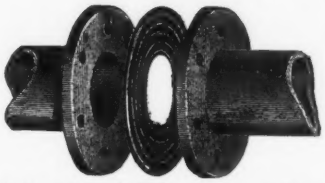
AND



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They Save Steam and Make Absolutely Tight Joints

United States Mineral Wool Co.
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THE BEST RUBBER VALVES AND DISCS

HARD— for Hot Water, Oil and AIR Pumps.

MEDIUM— for Steam and WATER

SOFT— for Cold Water.

Do not BREAK, CHIP or SEPARATE

Resist high TEMPERATURE

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OXIDIZED RUBBER WORKS

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Black Squadron Four Wedge Ring Packing

It makes a great deal of difference in power cost and trouble if the packing used is not BLACK SQUADRON. Things won't run easy.

Engineers—Send us your name and business address and we will send you FREE of COST a generous supply of BLACK SQUADRON FOUR WEDGE RING PACKING and a book full of information and helpful hints.

CANCOS MANUFACTURING CO.
146 N. Second Street, PHILADELPHIA, PA.

NEXT MONTH

With September comes an end to the summer drag. Men return from their vacations improved in health and spirits, and with new ideas and greater hopes.

It is said that more improvements and business schemes "sprout" in the early autumn than at any other season. The commercial agencies all report good prospects for fall business, therefore September should be a good time to increase your advertising, get out new copy, new and attractive illustrations and perhaps larger space thus producing a "well dressed" appearance that will attract more attention to your announcements.

STEAM FITTING

if not properly done, in any plant, will cause the engineer a great deal of trouble, and his employer unnecessary expense. Many years of practical experience and a force of competent assistants enables me to guarantee absolute satisfaction.

WILLIAM MILLIGAN, Shop, 726 Sansom Street, Philadelphia, Pa.

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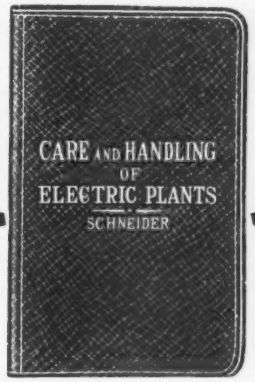
A NEW AMERICAN BOOK



Limp Leather, by mail for $1.00

Send in your order NOW

Full descriptive circular and sample pages FREE

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Publishers of Books for Engineers

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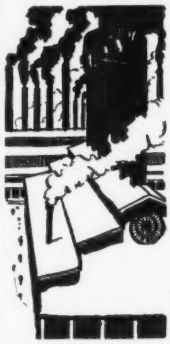
CRANE FITTINGS

ESTABLISHED 1855

SHUTTING DOWN FOR REPAIRS,



standing still, dead machinery, pays nothing in the coin of results. You reach that point by sticking to poor paints. Dynamos, engines and machinery give highest measure of service when you use

Wisconsin Graphite Roof and Stack Paints.

Preserving, smooth and lasting.

Write today for samples and prices.

WISCONSIN GRAPHITE COMPANY, PITTSBURG, PA.

ADVERTISE IN THE PRACTICAL ENGINEER

Send us two ounces of scale, by mail, or one gallon of water, by express prepaid. We shall make an analysis free of charge, and give you our opinion of the grade of Compound you should use in your boilers.

RED SEAL BOILER COMPOUND

THE CHERRY CHEMICAL COMPANY

MANUFACTURERS

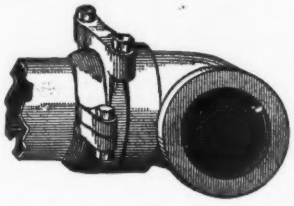
Office; 1215 Filbert Street, - Philadelphia, Pa.

Circulars, Prices and Directions Furnished on Application

REGISTERED TRADE MARK AGENTS WANTED WRITE FOR TERMS

Permanent Results

can be obtained only by using Smith's Clamp for stopping leaks in pipe joints.



This Clamp is simple in construction and is guaranteed to

STOP THE LEAKS

Made in all sizes, brass or steel Send for circular and discounts.

W. Clifford Smith

140 N. Sixth St. PHILADELPHIA

Watt's Perfect Wedge Packing

FOR EITHER HIGH OR LOW PRESSURE

Holds steam, water, air or ammonia with less friction on the rod than any other. Write for trial order today.

Watt's Best Sheet Packing

It is best because it makes any kind of a joint tight and keeps it tight. Used for oil, acid, steam, ammonia and water. It is the lightest and purest Rubber Packing made and can be used over again, and will not become hard under the highest steam pressure.

Manufactured by JOHN M. WATT'S SONS

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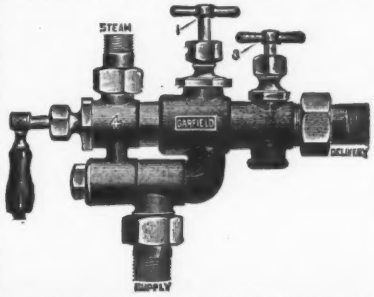
123 South Second Street, :: PHILADELPHIA, PA.



POWER PLANTS

Equipped with Garfield, Double Jet Injectors and Chicago Sight Feed Lubricators are as satisfactory to the owner as to the engineer.

Boilers steam easily and engines run smoothly.

Send for catalogue and mention THE PRACTICAL ENGINEER.

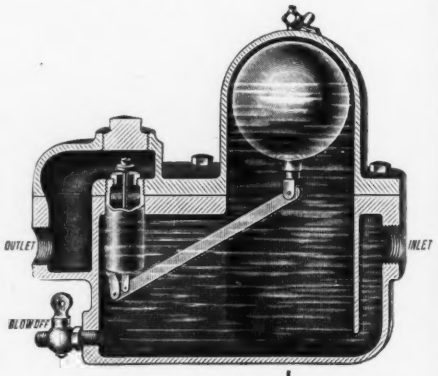
The Ohio Injector Company

WADSWORTH, OHIO

The Wright Idea in a Low-Pressure Steam Trap

is one having a valve that is **approximately as large as the pipe connection.** With a valve of this kind there can be no doubt about the Trap's ability to take care of all the condensation that comes to it. Isn't that reasonable?

And, by the way, when a Trap is working on low-pressure, the condensation doesn't come to it in **homeopathic doses.** A good Low-Pressure Steam Trap must have a valve capacity capable of handling a **flood** if necessary.



The Wright "Victor" Low-Pressure Steam Trap

wins out on that point. Put it at work on any steam pressure from 0 to 20 pounds—then forget it. It will be there ready for whatever amount of condensation comes to it.

Write us for particulars to-day—or tomorrow if it suits your convenience better—but write us.

WRIGHT MANUFACTURING CO.

72 Woodbridge Street DETROIT, MICH., U. S. A.

How about this Trap for your Heating System ?

STEAM TRAPS "Nason" and "Sidelug"

"Nason" Trap
For pressures to 70 lbs.

THE STANDARD FOR SIXTY YEARS

"Sidelug" Trap
For pressures from 70 to 150 lbs.

The practical engineer wants nothing but practical devices in his plant. The simplicity of the "Nason" Trap renders it eminently practical. Its design embodies the only correct principle, as is evidenced by its large and continuous sale since its introduction in 1842.

All parts of the "Nason" and "Sidelug" Traps are so removed from contact with dirt and scale as to render their stoppage impossible, thereby indefinitely prolonging their integrity.

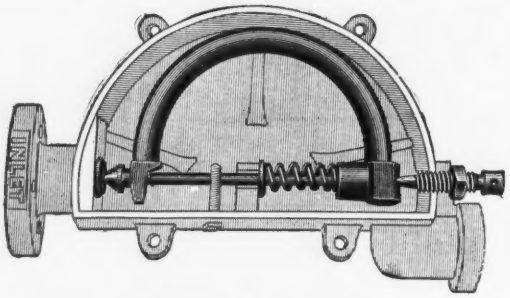
Nason Traps are "built for business"—no flimsy material and slip-shod workmanship—consequently no trouble and no leaks.

Wherever condensation is to be removed without waste of steam the "Nason" and "Sidelug" Traps can be successfully applied.

Every Steam Trap Bearing Our Name is Tested and Guaranteed. Reject Imitations. Complete Catalogue on Application.

NASON MANUFACTURING CO.

Beekman Street NEW YORK



Heintz Steam Savers

When properly installed—and we furnish plans and instructions without charge—the Heintz will save at the coal pile, its cost several times a year, besides increasing greatly the efficiency of any heating system or steam controlled apparatus to which it may be attached.

Reliable, accurate, durable, no floats, no complications, just results. Guaranteed or no pay.

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136 SOUTH FOURTH STREET. PHILADELPHIA

Pacific Coast Agents, California Engineering and Construction Co.
RIALTO BUILDING, SAN FRANCISCO, CAL.

For Sale by all Leading Supply Houses

Every Engineer should send for A Free Sample

Practical Belt Stick

No more lost power from slipping belts. Every engineer who try's it says it's the best he ever used.
Prolongs life of belt and never slips.

SEND FOR SAMPLE TO-DAY

Practical Manufacturing Co.
RICHMOND, INDIANNA.

Lamprey Protective Arch Plates

Protect your boiler fronts from burning out, preserve the brick work, save fuel, and increase the efficiency of your boiler, by giving additional heating surface. Save their cost in repairs alone.

Send for catalog
THE LAMPREY CO.
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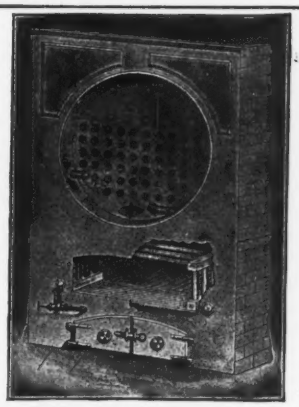
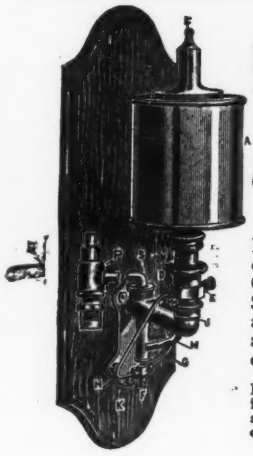


THE CARR PUMP GOVERNOR

Superior to any pump governor on the market "why" Because the cylinder will not LIME, Prevents the pump from RACING in case of a bursted main or hose, Fitted with Renewable Compensating Valve and Seats, Regulation perfect. Especially adopted for Fire and Water Works Pumps, Send for catalogue, 30 days trial.

E. M. CARR,
NEW CASTLE, IND., U. S. A.



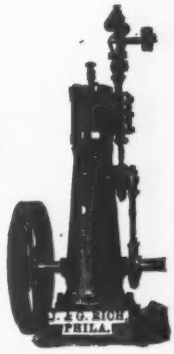
IMPROVED
Kellam Damper Regulators
The Simplest and Closest Damper Regulator.
Manufactured by
J. E. Lonergan & Co.
211 RACE ST., PHILA., PA.

Brass Founders and Finishers and Makers of Pop Safety Valves, Water Relief Valves, Oil Cups and Lubricators, Steam Pressure Regulators and other safety steam appliances.

Old Kellam Regulators Repaired. Correspondence Solicited.
Mention this paper if your inquiry is prompted by the sight of this advertisement. Catalogue D free on application.

ESTABLISHED 1871.
J. & G. RICH
General Machinists
ENGINE BUILDERS
AND DEALERS IN MACHINERY.

Especial Attention Given to Repairing and Erecting Steam Engines, Pumps and Other Machinery, Shafting, Hangers, Pulleys, Etc., Etc.



120 North Sixth Street, Philadelphia, Penna.
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Over 500 Articles to Select From

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FOR TWO
"STEAM STOPPER"
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CERTIFICATES
Write for list and full explanation.

For Two Certificate

1. 1-in. Williams' single-end wrench (finished).
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4. 12-in. Monkey wrench and bicycle wrench.
5. Combination tool set (9 small tools, in hollow handle).
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7. Starrett's 12-in. scale.
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9. Starrett's screw pitch gauge, No. 4, 24 pitches, 4 to 30 thread.
10. Starrett's thickness gauge, No. 172, Eight leaves.
11. Starrett's mercury plumb bob, 3½ oz.
12. Nickle plated adjustable hack saw frame. Takes 8 to 12 blades.
13. Starrett speed indicator.
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15. Starrett spring inside caliper, 6 or 8 in.
16. Starrett " dividers.
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FRANCE PACKING CO., Incorporated.
6514 State Road, Tacony, Philadelphia.

Remember the Trade Mark

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18. 6-in. Trimo, or Stillson wrench.
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20. 10-in. Trimo, or Stillson wrench.
21. 6-in. combination pliers (nickle plated).
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23. ⅛ to 1-in. Barnes' three wheel pipe-cutter.
24. Pike India oil stone in box.
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27. Hawkins' Indicator catechism.
28. Washer cutter, cuts to 6 in. Two cutters.
29. Combination knife or screw-driver.
30. Billings & Spencer magazine screw-driver, 4 blades.
31. Ingersoll watch, guaranteed.
32. Pocket knife, 4 blades.
33. One set of steel figures, ⅛ in.

We Manufacture Packing for all Purposes and guarantee it.

WHEN THE

BOILER FEED-WATER

contains objectionable ingredients, such as SCALE-FORMING MATTER, it deposits as scale, regardless of the type of boilers, the steam pressure carried, or the care and attention with which the boilers are operated.

There are all sorts of beautiful theories launched for the prevention and removal of scale, but we have never seen any other practical way of keeping the boilers clean than by causing

CHEMICAL REACTIONS

to take place between the scaling-salt and some reagent which converts these incrusting solids into such condition that they will not adhere as scale, but can be blown out and readily washed out when boilers are open.

To accomplish these results without injurious action to boilers, it must be done with a *vegetable treatment* properly proportioned to suit the water, as per analysis. Vegetable Treatment requires high temperature to best bring about the reactions and should, therefore, be used through the heaters to the boiler, or direct into the boilers.

Send us a gallon sample of water for complete Mineral Analysis. We will send you report and our proposition, telling you the treatment required, amount necessary to be used, the price, etc.

NO MATTER WHERE YOU ARE LOCATED, we can point to many boiler plants we are successfully keeping clean not far from you.

WRITE FOR BOOKLET "N"

DEARBORN DRUG AND CHEMICAL WORKS

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The Garlock Valve

is the only guaranteed one on the market.

Our very large experience in connection with pumping machinery enables us to compound a valve to meet any and all requirements, and we guarantee them to give absolute satisfaction or money is refunded.

Style No. 108 for Hot Water any Pressure.
Style No. 139 for Cold Water, Medium Pressure
Style No. 188 for Cold Water, High Pressure
Style No. 152 for Condensers

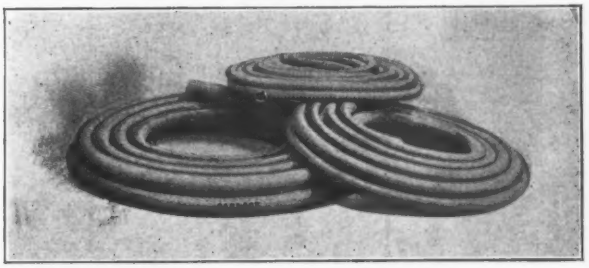
Our Trade Mark is a symbol of reliability efficiency and economy.

GARLOCKS HIGH GRADE PACKINGS

Our Trade Mark is a symbol of reliability, efficiency and economy.

Garlock Steam Hose

will positively withstand steam pressure longer than any other Hose made without vulcanizing. Our great success is due to applying the same compound in the hose lining that we have used in our well known high grade Steam Packing for years with unequalled results.



WE GUARANTEE ALL GARLOCK PRODUCTS. WRITE FOR CATALOGUE.

GARLOCK PACKING COMPANY

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Factories

PALMYRA, N. Y. SAN FRANCISCO, CAL.
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Philadelphia New York Boston Chicago
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Denver Palmyra, N.Y. San Francisco.
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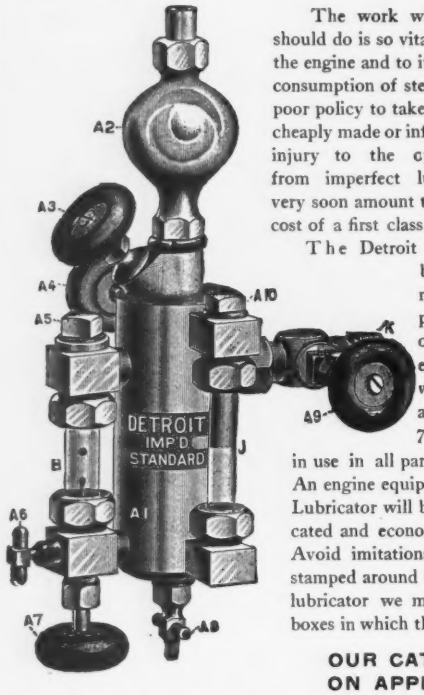
The Importance of a Reliable Lubricator



The work which a lubricator should do is so vital to the welfare of the engine and to its efficiency in the consumption of steam that it is very poor policy to take any chances with cheaply made or inferior goods. The injury to the cylinders, resulting from imperfect lubrication, would very soon amount to several times the cost of a first class lubricator.

The Detroit Lubricators have been used by fully nine-tenths of the prominent builders of American steam engines for upwards of 25 years, and there are over 700000 of steam in use in all parts of the world. An engine equipped with a Detroit Lubricator will be perfectly lubricated and economically operated. Avoid imitations. Our name is stamped around the body of every lubricator we make, and on the boxes in which they are packed.

OUR CATALOGUE ON APPLICATION

Detroit Lubricator Company, DETROIT Mich.

There is as much Belt driving energy in a pound stick of STEPHENSON DRESSING as in a gallon of soft stuff.

(We sell both kinds.)

If you are a stickler for QUALITY we get your trade.

If you count the COST—figure Stephenson Bar as seven and a half times cheaper than a liquid.

If you study your own CONVENIENCE we get your trade anyhow.

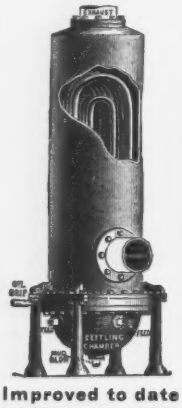
STEPHENSON MFG. CO.

ALBANY, N. Y.

FREE—We are giving Hawkins' Complete Works as premiums for new customers.

Write us to-day for full particulars.

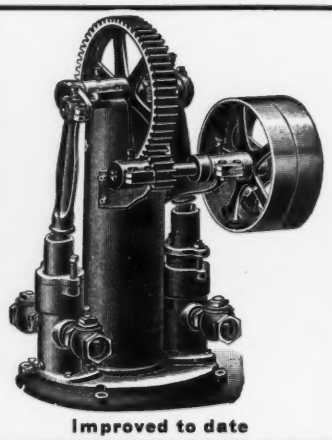
The Practical Engineer's Favorites



Improved to date

Improved to Date

Improved to date

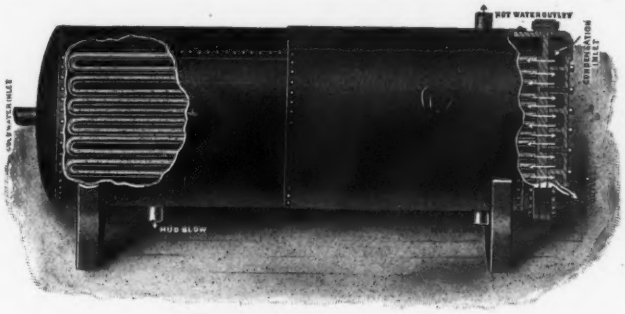


Improved to date

All Practical Engineers like our specialties, (FEED WATER HEATERS; EXHAUST HEADS; SEPARATORS and BELT PUMPS) because they are IMPROVED TO DATE. Because they have so many unusually good points about them. Write us, we will tell you what they are. Remember we can't get hold of your name unless you write us first.

FRANK L. PATTERSON & CO.

24 CORTLANDT STREET **MANUFACTURERS** **NEW YORK**



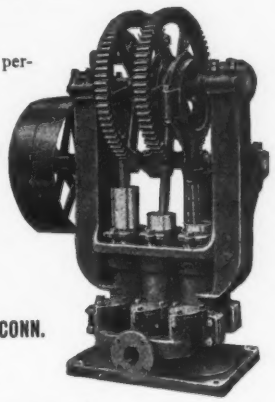
The GLEANER TRADE MARK

The **Gleaner** represents the acme of perfection in feed water heating.

THE

Davis Triplex Power Pump

is a perfect type of the vertical triplex belt driven pump.



MANUFACTURERS OF
The "Berryman" Feed Water Heater and Purifier.

I. B. DAVIS & SON, HARTFORD, CONN.

WRITE FOR CATALOGUE, ETC., TO

THOS. McADOO, 125 N. 4th St., Philadelphia

THE **OTIS** Tubular Feed

WATER HEATER, OIL SEPARATOR and PURIFIER

with Seamless Brass Tubes

Guaranteed

To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

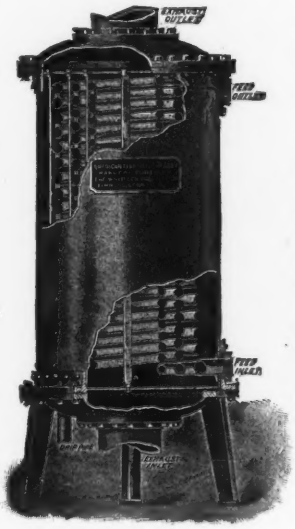
A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

The Stewart Heater Co.

11 Norfolk Avenue, Buffalo, N. Y., U. S. A.

THE AMERICAN STANDARD COPPER COIL FEED WATER HEATER



Simplicity!
Strength!
Economy!
A Money Saver!

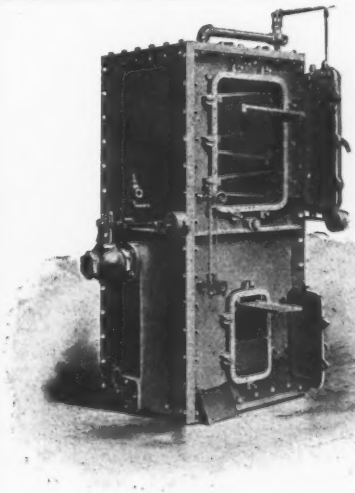
It gives so little trouble that one of our customers, who has used one for three years, had forgotten that he had it when we asked him the other day how it was doing. He called in the engineer, who said it hadn't been touched since it was put in and was still heating the water to 210 degrees.

That's the kind of a Heater you want.

Write for Catalogue No. 100 P

The Whitlock Coil Pipe Co.

HARTFORD : CONNECTICUT



A Vacuum

"A vacuum," said a small boy in school, "is a large hole with a smaller hole inside of it."

A little "vacuum" in the right place is the peculiar feature that makes

WEBSTER FEED-WATER HEATERS AND PURIFIERS

so remarkably efficient. It not only saves steam, but also prevents "back pressure" on the engine. It seems paradoxical to say that WEBSTER HEATERS show full efficiency when using steam at less than atmospheric pressure, but it is so.

Vacuum has a "pull," you see.

WRITE FOR BOOKLET.

Warren Webster & Co.

CAMDEN, NEW JERSEY

HF

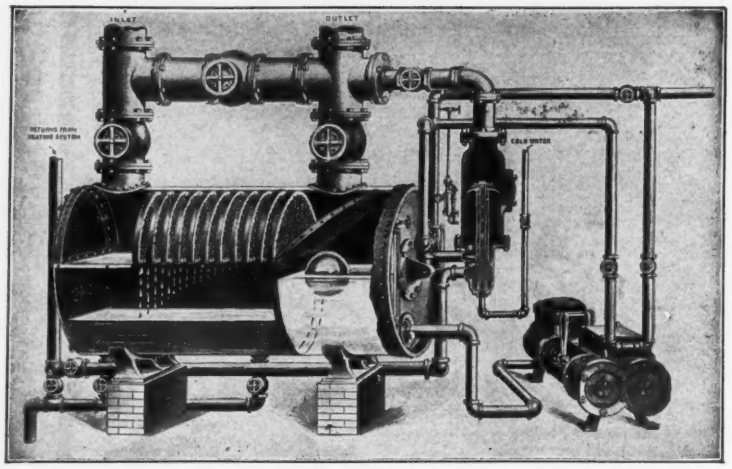
"Utility" STEAM SPECIALTIES

WE POINT TO WHAT
WE'VE DONE AS PROOF
THAT OIL CAN BE ENTIRELY
REMOVED FROM EXHAUST STEAM
AND THAT FEED WATER CAN BE HEATED
ABOUT TO THE TEMPERATURE OF THE EXHAUST BY

Our "Utility" Combination

We can always guarantee an elimination of 98 per cent. at the outlet point af separator. We average over 99 per cent and have in some cases left but 8-10,000 of 1 per cent. of oil in the water. You can't see this amount, you can't taste it; fresh well water frequently has more oil in it, and this water can be used for fifty years in boilers without showing a trace of oil deposit. The feed water heating feature is optional, but very efficient, free from back pressure and requires but little room and no floor space.

The "Utility" Combination serves as Exhaust Muffler, Oil Separator, Return Tank, Pump Governor and Feed Water Heater. It costs only about as much as a Feed Water Heater.



"Utility" Pump Governor

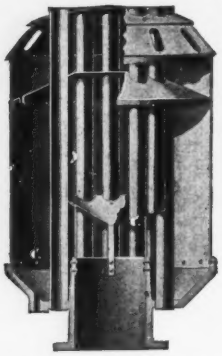
The best Pump Governor on the market. Why? Because our valve will not leak or stick; we guarantee it to absolutely govern the pump and remain tight for five years. Compare the construction of our valve with any other on the market. By adopting the "Utility" you can save coal and get a higher temperature from your heating or drying systems. Send for catalogue and list of users.

A New Application

of the chain baffle plate principle which has proven so successful in the oil eliminator may be found in our

Steam Separator

and the efficiency of it is very high. Absolutely dry steam, absolutely no back pressure. What more could you ask?



UTILITY EXHAUST HEAD
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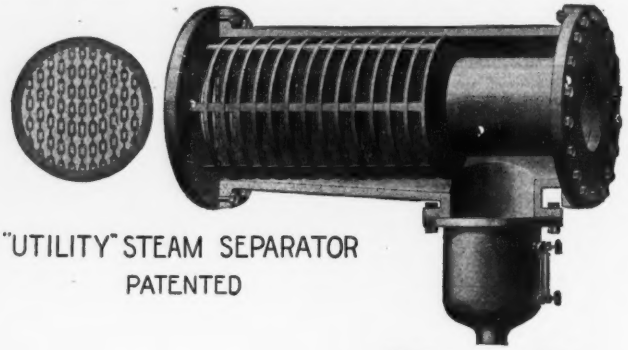

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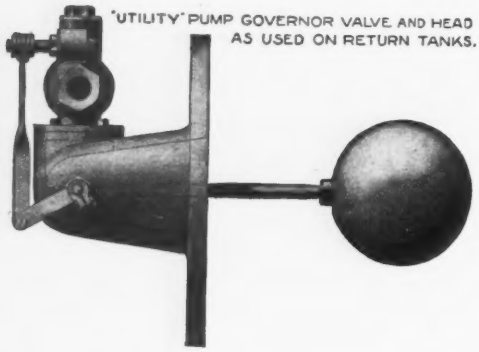

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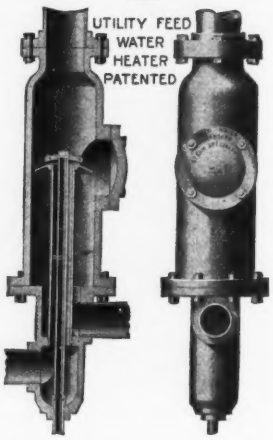

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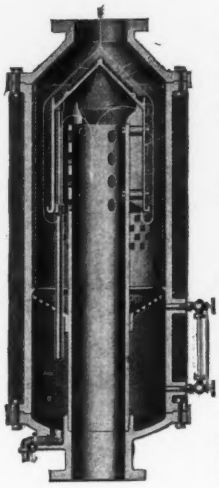

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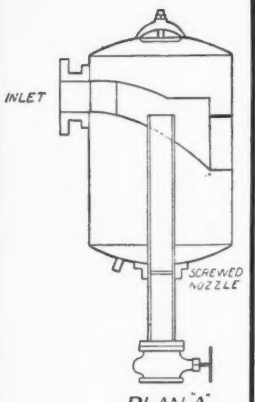
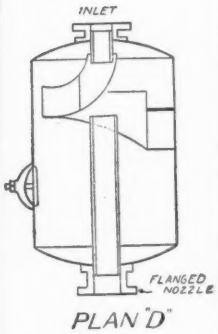


PLAN "A"



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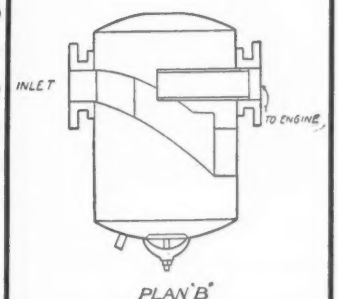
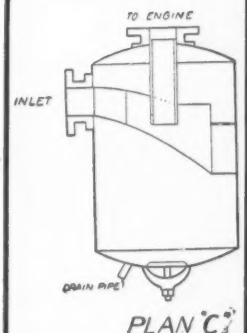


PLAN "B"



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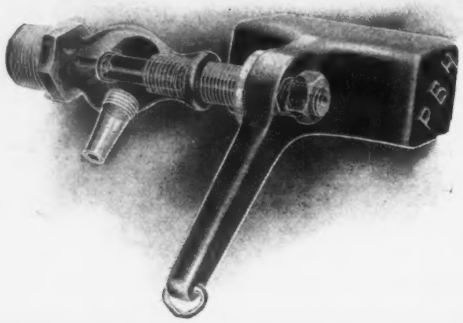

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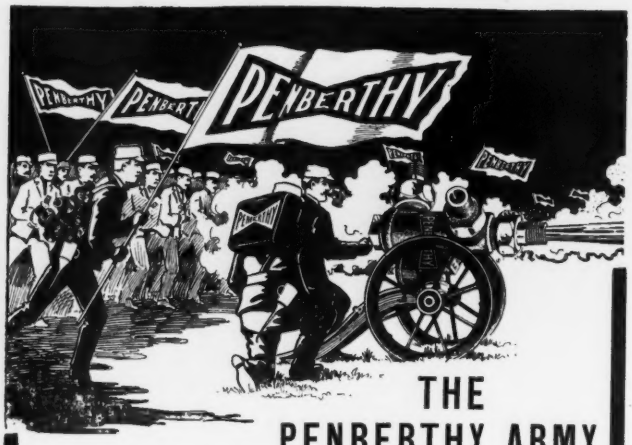

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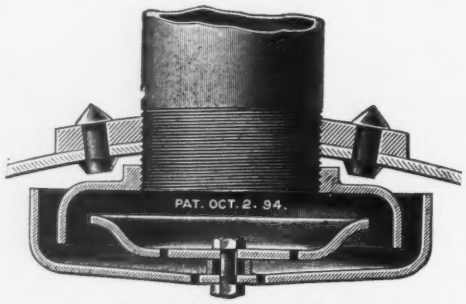

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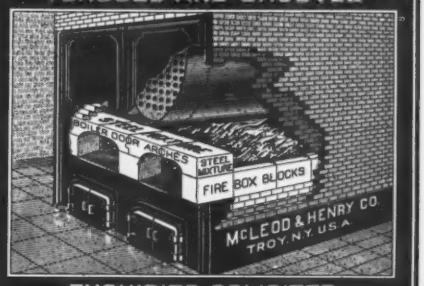

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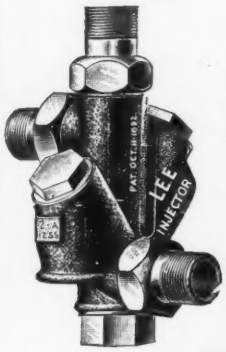

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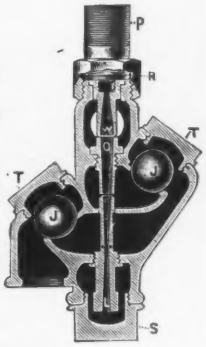

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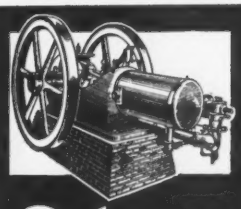

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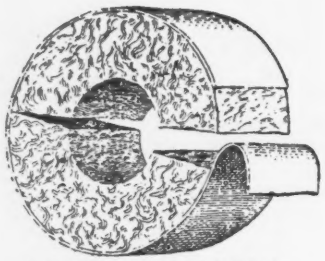

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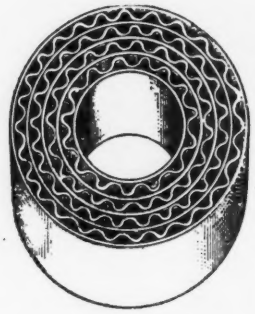

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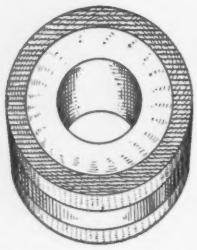

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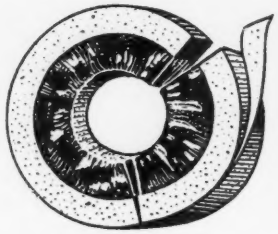

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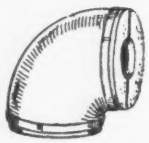

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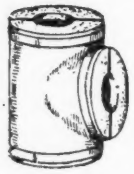

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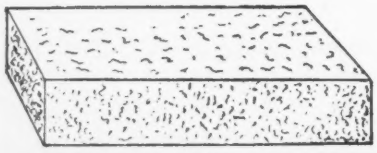

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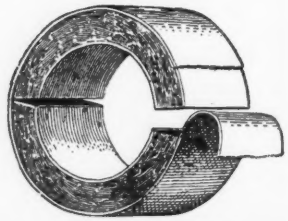

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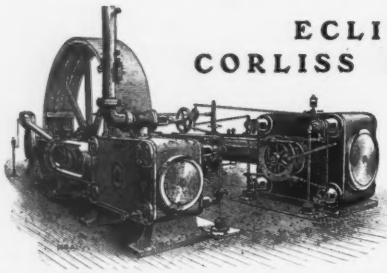

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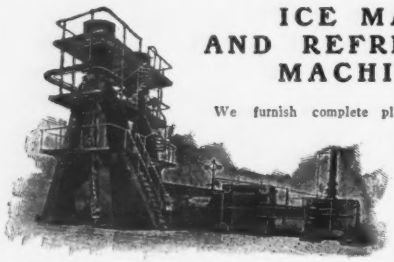

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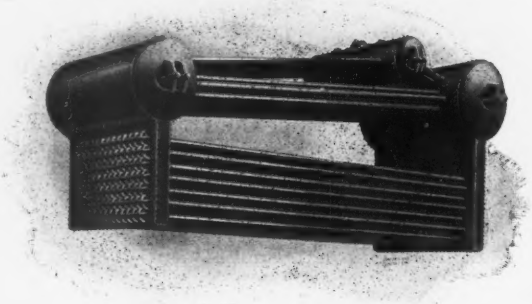

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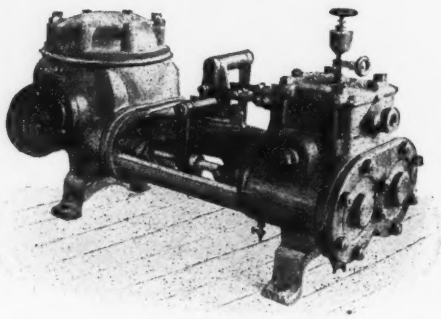

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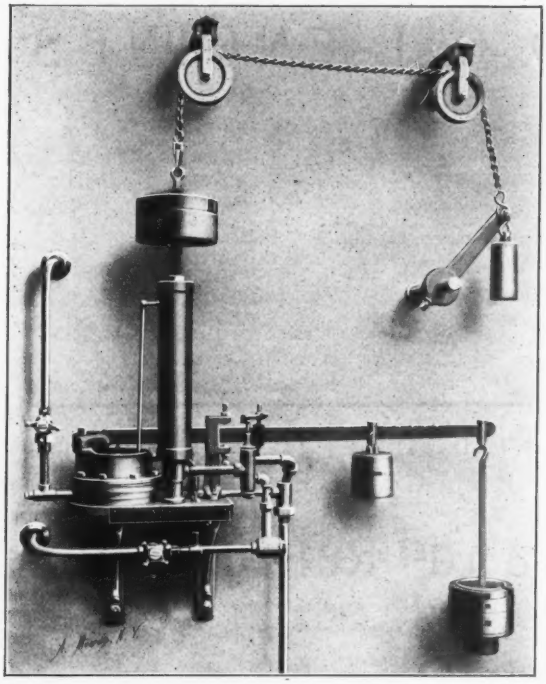

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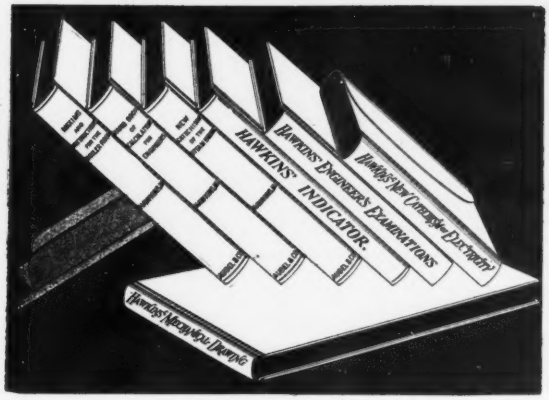

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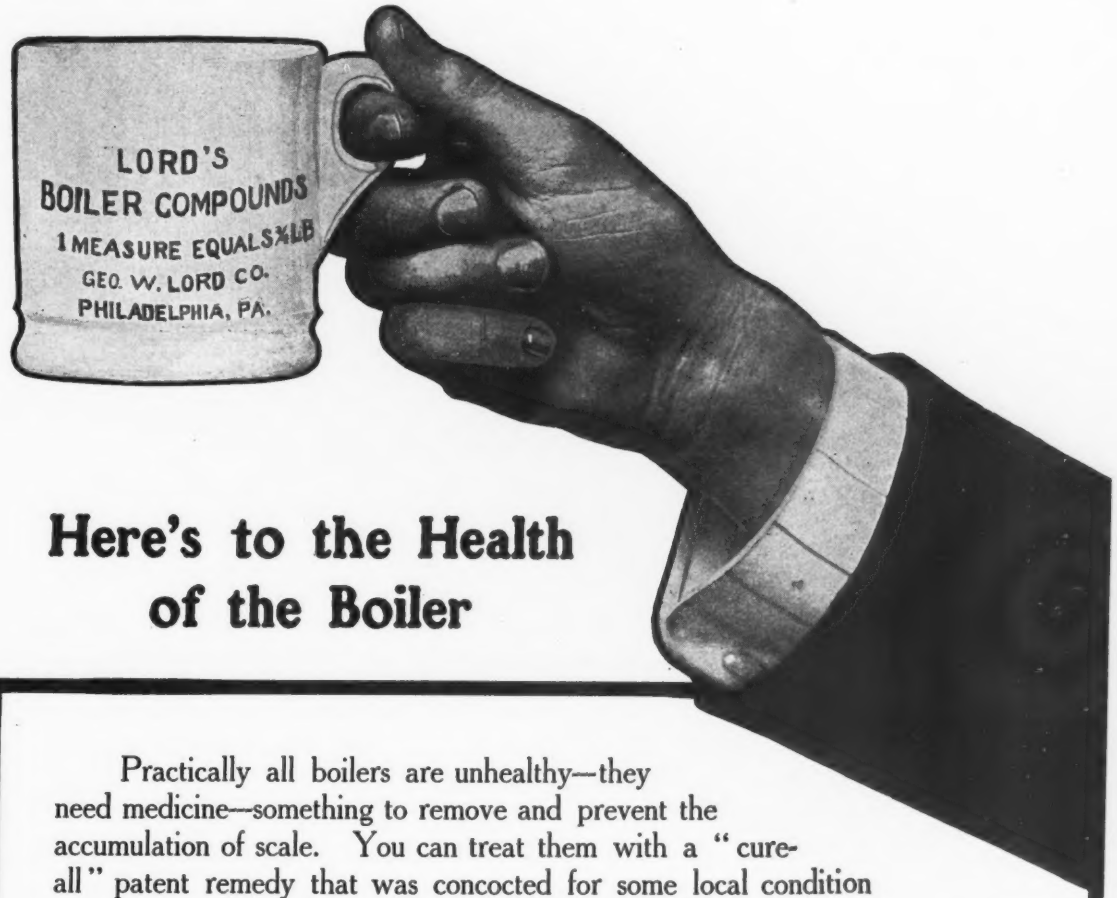

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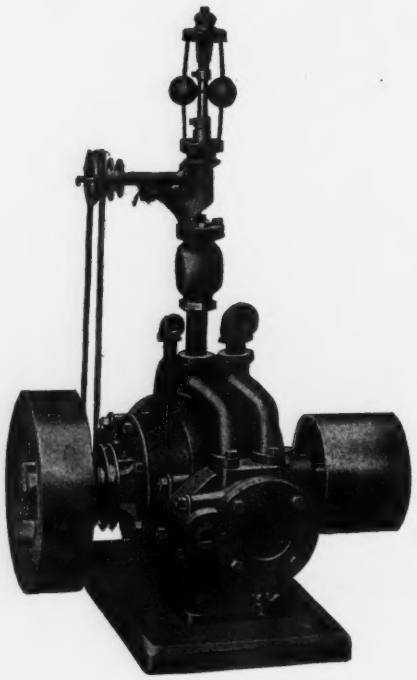

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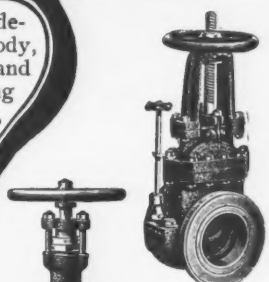

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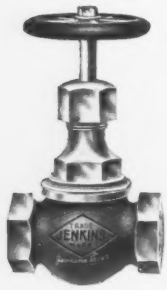

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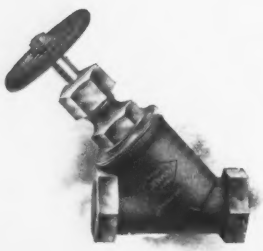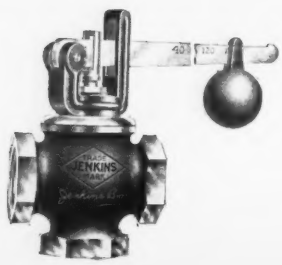
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